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The Molluscan Macrofauna of the Reklaw Formation, Marquez Member (Eocene: Lower Claibornian), in Texas

by

Christopher L. Garvie

Paleontological Research Institution
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THE MOLLUSCAN MACROFAUNA OF THE REKLAW FORMATION, MARQUEZ MEMBER (EOCENE: LOWER CLAIBORNIAN), IN TEXAS

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ABSTRACT

An abundant and well-preserved molluscan fauna from the Marquez Shale Member of the Reklaw Formation in East and Central Texas contains more than 188 species of molluscs, of which 123 are referred to new species, 6 to new subspecies, and 38 can be referred to previously described forms. A further 16 can only be generically assigned. Four new genera, and two new subgenera are defined. The majority of specimens came from two localities, Joe Taylor Branch of Two Mile Creek in Milam County, and Ridge Creek in Bastrop County. Two suites of specimens from the Texas Memorial Museum and the Philadelphia Academy of Natural Sciences respectively were also examined, as labels indicated a Reklaw age. Both of these suites were collected in the 1890's, and although possibly collected in the Reklaw formation, it is believed they are more likely to have come from the Queen City or Weches formations; they are also treated in the text. The character of the deposits and the conditions under which the associated fauna of corals, bryozoans, vermes and vertebrate remains is found, suggest a near shore, open marine environment. The fauna is a mixture of lagoonal elements, some with signs of wear, an open sea, near-shore component, and a very well-preserved, size-sorted marine component from deeper water. A few brackish water species and one possible fluviatile species could indicate the proximity of estuarine conditions. Most of the new species and genera were found in several exposures in Joe Taylor Branch of Two Mile Creek. Many of these localities were not previously known to be fossiliferous. The stratigraphy of several sections is described on Joe Taylor Branch. All previously described fossiliferous localities of the Marquez Shale Member of the Reklaw Formation were revisited, and collections made if possible.

The following new genera and subgenera are proposed: Bivalvia: *Tenuimactra*; Gastropoda: *Pseudometula, Trimalaxis, Hastula (Bulbihastula), Surculoma (Volutapex), Eocythara*. The following new species and subspecies are proposed: Scaphopoda: *Dentalium (Antalis) palmerae, Fustiaria (Episiphon) aciculata, Cadulus bisissura;* Bivalvia: *Nucula cochlear, Nuculana (Jupiteria) turgeo, Nuculana (Saccella) demissa, Litorhadia milamensis, Litorhadia undulata, Litorhadia valdefragilis, Barbatia (Acar) salebrosus, Barbatia (Cucullaearca) reklawensis, Bathyarca claibornica, Pachecoa (Pachecoa) concentrica, Gregariella ridgei, Amusium (Propeamusium) zinguli, Plicatula pustula, Hyotissa offemanae, Anodontia (Eophysema) reklawensis, Chama taylorensis, Venericor densata reklawensis, Claibornicardia milamensis, Claibornicardia linguinodifera milamensis, Tenuimactra hodgkinsoni, Eosolen shirleyi, Tellina (Eurytellina?) milamensis, Pitar (Calpitaria) turneri, Caryocorbula marquezensis, Notocorbula marquezensis, Bankia (Lyrodobankia) petalus, Cochlodesma (Cochlodesma) ovalis, Cardiomya? fredsmithi;* Gastropoda: *Littorina (Prosthenodon) eofasciata, Tubiola gracilis, Solariorbis discoides, Solariorbis conicus, Solariorbis? parsnaticoides, Theodoxus domicilium, Mathilda (Echinimathilda?) cribraea, Mathilda (Fimbriatella) iugum, Litiopa texana, Bittium (Bittium) tresquatrum, Bittium (Bittium) ridgei, Glyptozaria americanae, Pseudomalaxis reklawensis, Pseudomalaxis acuta, Architectonica (Stellaxis) reklawensis, Architectonica (Patulaxis?) fimbiaea, Architectonica (Granosolarium) aldrichi caterva, Architectonica (Granosolarium) geminicostata, Trimalaxis ora, Serpulorbis? multiclavus, Amaea (Scalina) macula, Amaea (Foratiscala) texana, Rugatiscala cooperi, Amaurellina plummeri, Natica (Naticarius) brevisulcata, Natica (Carinacca) moffitti, Polinices (Pliconacca) onustus reklawensis, Sinum taylori, Sinum moveum, Postalia americana, Neosimnia scobina, Cypraeorbis bulbus, Phalium (Semicassis) reklawensis, Ficopsis nucleoides, Hexaplex eoa, Mitrella (Clinurella) nuttalli, Mitrella (Clinurella) nuttalli lineata, Metula elongatoides, Pseudometula gradus, Distorsio nucleoides, Colwellia bilineata, Tritiaria nodosa, Antillophos multilineatum, Buccinanops ellipticum reklawensis, Bullia altilis harrisi, Fusinus claibornica, Latrius (Polygona) traceyi, Mazzalina conica, Surculites lapillus, Clavilithes parvetorbis, Clavilithes? acus, Levifusus? serrae, Cornulina minax dockeryi, Sycostoma texana, Michela trabeatoides carinata, Euryochetus punctatum, Ancilla (Olivula) staminea reklawensis, Admetula irregularis, Trigonostoma (Ventrilia) herbae, Trigonostoma (Ventrilia) elegantissima, Trigonostoma (Ventrilia) jonesae, Volvariella milamemsis, Conus (Lithoconus) nocens, Coronia taylori, Hesperiturris nodocarinatus crassus, Hesperiturris? monilis, Hesperiturris? monilis levae, Domingella ridgei, Surculoma imbricata, Pyramimitra (Petrafixa) eocenica, Leptosurcula carinata, Eosurcula moorei reklawensis, Tropisurcula milamensis, Tropisurcula (Eodrillia) planus, Tropisurcula (Eodrillia) grandis, Protosurcula? aurora, Spirotropis claibornica, Eocythara texanum, Eocythara lineata, Varicobela filum, Raphitoma (Microsurcula) georgei reklawensis, Raphitoma (Microsurcula) bastropensis, Raphitoma (Microsurcula) iuventae, Hastula milamensis, Hastula (Bulbihastula) ampulla, Hastula (Bulbihastula) longifera, Mnestia rotunda, Mnestia confusa, Volvulella reklawensis, Retusa (Cylichnina) notata, Semiacteon texanum, Pyramidella (Syrnola) pirum, Pyramidella (Cossmannica) filamentosa, Pyramidella (Cossmannica) tundrae, Pyramidella (Cossmannica) tundrae zigguratum, Odostomia (Doliella?) ova, Turbonilla (Ptycheulimella) meta, Melanella minutissima, Umbraculum tomaculum.* Cephalopoda: *Belosepia pennae.*

Other proposed changes in taxonomic assignments include: *Eodrillia* is made a subgenus of *Tropisurcula. Pyramimitra* is removed from the Mitridae and placed in the Turridae. *Cyclostremiscus axacuus* replaces *Cyclostremiscus exacuus.*

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INTRODUCTION

I was prompted to begin collecting in the Reklaw by visiting stop 11 in a guide book by F. E. Smith (1962), and discovering a handful of well-preserved molluscs. This led to an investigation of the creekside exposures in the shale, from the roadside locality to the nearby Brazos River. The Eocene molluscan fauna of Texas has been known since Ferdinand Roemer's first discovery of fossils at Stone City Bluff on the Brazos River in 1846. Since that time a succession of workers, both professional and amateur, have collected and described the Texas faunas, particularly in the Weches and Cook Mountain formations.

Unlike Alabama, with its fine Sabinian and Claibornian Stage faunas, Texas has supposedly few surface exposures with good marine faunas between the Paleocene Midway faunas, monographed by Gardner (1933), and the Weches faunas of the lower middle Claibornian. A few brief references in the geological literature, however, gave reason to believe that such exposures exist. In 1980, I had the opportunity to investigate the surrounding areas in more detail, and some productive exposures were indeed found. Initial investigation centered on the Reklaw exposures near the Brazos River, and this was later increased to include the Reklaw exposures on and near the Colorado River. A search through the literature and further field work resulted in rediscovery of another locality in Rusk County. This report is the result of 12 years of intensive collecting in the Marquez Shale Member and is the first of a planned series. Later reports will cover the Seguin and other more minor faunas.

The Reklaw Formation consists of two members, the upper Marquez Shale member and the lower Newby Sand member. Both members weather rapidly, probably due to the decomposition of finely disseminated pyrite in the glauconitic sandy layers. Exposures of both members examined proved to be sparingly fossiliferous, usually with only leached imprints of the fauna. A few exceptional exposures in the Marquez Member provided the bulk of the specimens collected. The Marquez Shale Member has a higher clay and glauconite content than the Newby member, and fossils can be obtained after a flood has scoured the creeks, or by excavating. The lower Newby Member is also fossiliferous in east Texas, but is very prone to leaching due to the high sand content of the strata. Surface exposures in the east-central area between the Colorado and Brazos Rivers appear unfossiliferous. In easternmost Texas, Stenzel (1939) notes a fossiliferous layer in the Newby Member composed primarily of a subspecies of *Venericor densata* Gardner and Bowles, 1939; this area is not treated in this report. Some additional Reklaw molluscs were also found in the collections of the United States National Museum, the Academy of Natural Sciences of Philadelphia, and the Texas Memorial Museum. Few references have previously been made to the Reklaw faunas, and then often in such terms as "dwarfed faunas", and "small gastropods similar to the Stone City species". In contrast, my work in the Reklaw indicates that it contains a diverse and unusually well preserved macrofauna of molluscs, corals, bryozoans and fish remains.

This study is primarily a faunal description, and as such fills a chronological gap in the molluscan fossil record of the southern and eastern United States. The purpose is to provide a reference for the Reklaw molluscan faunas, and to stimulate further investigation of this neglected formation. All molluscan species are treated with the exception of the pteropods that were described in Hodgkinson *et al.* (1992). The limitations of time and residence have hampered the study somewhat, and it is likely that other fossiliferous localities in the Reklaw remain to be discovered. The material obtained, including many unique specimens, indicates the fauna is far more diverse than previously suspected, particularly as the present investigation only deals with a few exposures clustered around two areas; one centered on Joe Taylor Branch Creek in Milam County, Texas and the second around Ridge Creek in Bastrop County, Texas. The specimens obtained are the result of at least 100 collecting trips in the period 1980 to 1992. In addition to surface collecting, bulk samples of 20 kg. or more were normally collected on every trip from the small lenses of shell material that occur relatively frequently. The majority of the taxa, as might be expected, can be assigned with some confidence to an intermediate evolutionary position between similar Sabinian and Middle Claibornian forms.

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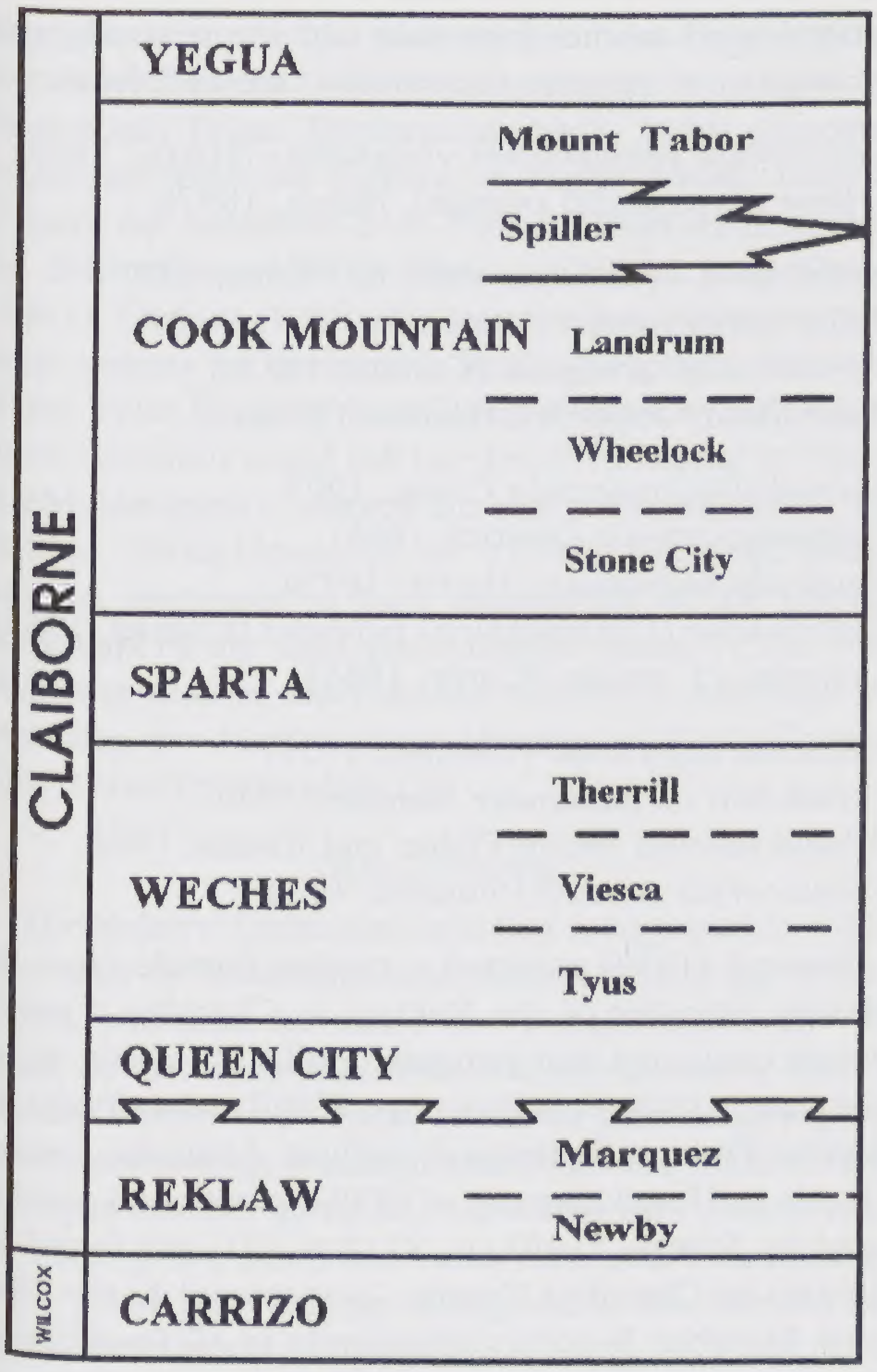
For the loan of specimens the author is indebted to T. W. Waller and F. Collier from the United States National Museum, S. Horenstein from the American Museum of Natural History, to P. Hoover from the Paleontological Research Institution, C. W. Copeland from the Geological Survey of Alabama, Dr. van den Borg from the Louisiana Museum of Geoscience, G. Rosenberg from the Academy of Natural Sciences of Philadelphia, D. T. Dockery III, from the Mississippi Bureau of Geology, S. Tracey in England, and to C. Durden from the Texas Memorial Museum where the Bureau of Economic Geology collections are now curated. Steve Tracey also helped in locating several obscure references in the library of the Natural History Museum, London. I am particularly grateful to my three reviewers, W. D. Allmon, D. T. Dockery, and T.



Text-figure 1.—Eocene stratigraphic units in Texas (from Stenzel *et al.*, 1957; Sams and Gaskill, 1990; and Yancey, pers. comm.).

E. Yancey for their thorough review of the draft; their many comments and suggestions have greatly improved the manuscript. In addition the extensive collections and library of the Natural History Museum, London were kindly placed at the author's disposal while in that country by C. P. Nuttall and J. Cooper. The Bayerische Staatsbibliothek in Munich, Germany furnished many rare books not found elsewhere. In the U.S.A., C. Jones and E. Benamy made the collections at the Academy of Natural Sciences in Philadelphia available for study, and P. Hoover placed the Paleontological Research Institution's collections at the author's disposal during several visits there. D. Steere supplied several obscure references at the Smithsonian Institution Libraries. The author is particularly grateful to C. P. Nuttall and C. Jones for their expertise and advice during the early part of this study as difficulties arose. During the long life of this study I have benefited from the suggestions and help of many others, and to all of them I am very grateful. The study might have taken considerably longer without their help. My wife Shirley spent many tedious hours checking many versions of the manuscript and for her patience and endurance I am very grateful.

HISTORY

The Reklaw Formation was regarded as being of Claibornian age as early as 1889 when Penrose (1889, pp. 29–30) described the Colorado River sections from Austin to Smithville. The first fossiliferous exposure downstream from the Travis County line is Bombshell Bluff, an exposure of Reklaw strata which was described as: "consists of thin interstratified layers of glauconitic marl, black clay, and dark siliceous sand with glauconitic specks, . . .". Four miles below this first exposure is "Devil's Eye" where Penrose remarks on "similar ledges of the same strata". The "Devil's Eye" locality does not appear to exist now, and it is believed from the faunal content that this locality should now be referred to the Queen City Formation, although uppermost Reklaw is possible. This fauna shows a greater similarity to the Weches fauna than any of the personally collected Reklaw material. The first determination of some fossils from this locality was made by Heilprin (1891); these were sent to him by Penrose from exposures on Devil's Eye, these were identified as:

Conus sauridens (Conrad, 1833b)
Pleurotoma Tuomeyi Aldrich, 1886
Pleurotoma nodocarinata Gabb, 1860d
Distorsio (Personella) septemdentata (Gabb, 1860d)
Astarte tellinoides Conrad, 1833c
Nucula magnifica Conrad, 1833a
Mitra? sp
Volulithes petrosus? Conrad, 1833a?
Xenophora confusa Deshayes, 1832a
Cytherea Nuttalliopsis Heilprin, 1881
Cardita tetrica Conrad in Wailes, 1854
?Limopsis corbuloides Conrad, 1833b

The other species previously described as occurring in the Reklaw Formation are:

Ancillaria staminea Conrad, 1832b
Orthoyoldia psammotaea vivianensis (Harris, 1919)
Venericardia (Venericor) claiboplata Gardner and Bowles, 1939
Cancellaria sp. *
Latirus aff. L. moorei (Gabb, 1860) *
Murex sp. *
Natica sp. *

Pleurotoma cf. P. texanopsis Harris, 1895a*
Pleurotoma carlottae Harris, 1899 *

Sigaretopsis sp. *

Turritella n.sp. *
Turris cf. T. moorei Gabb, 1860 *
Corals 3 spp. *
Lirodiscus smithvillensis (Harris, 1895a)
Athleta petrosa smithi Fisher and Rodda, 1964
Echinochilus texanum (Harris, 1895a)

Turritella turneri Plummer, 1933
Volutocorbis stenzeli Plummer, 1933
Volvaria gabbiana (Harris, 1895a)
Xenophora confusa (Deshayes) Heilprin, 1891
Terebellum sp. (Harris, 1890)

Katherinella? trigoniata bastropensis (Harris, 1919)
Venericardia cf. V. densata Conrad, 1845*
Glycymeris sp. *
Angulithes elliotti (Stenzel, 1940)
Aturia turneri Stenzel, 1940

The species marked with an asterix were identified by F. E. Turner, and come from the "old Copper prospect", Alsobrook land, Pullen Survey, 4 1/2 miles NE of Harwood, Caldwell County, Texas, and were deposited in the Bureau of Economic Geology in Austin. The lists were compiled from information in Palmer and Brann (1965), Sellars *et al.* (1932), and Heilprin (1891). An attempt was made to locate Penrose's specimens in the Academy of Natural Sciences in Philadelphia, and also to locate the species identified by Turner in the Bureau of Economic Geology collections, now transferred to the Texas Memorial Museum, but no positive identifications could be made. Whether all of the above species even came from the Reklaw is questionable. Several specimens now in the Texas Memorial Museum, that are identified as coming from the Reklaw Formation, and not personally found in the present study, were critically examined. These are believed to be lowermost Weches Formation or Queen City Formation in age. Samples of matrix from within the aperture of two gastropods were found to contain foraminifera known to occur in the Weches. Whether the foraminifera also occur in the Reklaw is not known. The distance from the uppermost Reklaw locality to the lowermost Weches on the Colorado river is only 2.4 km (=1.5 miles), and at the turn of the century, the two formations were united within the Timber Belt or Sabine River beds (Fisher, 1961), which might explain the mixing within the collections.

Other species whose range includes the Reklaw, but have not yet been recognized in the formation are:

Bonellitia tortiplica? (Conrad, 1865a)
Bullia altilis subglobosa (Conrad, 1832b)
Euspira leana (Palmer, 1937)
Galeodea dubia (Aldrich, 1885)

Species previously recognized in the Reklaw, or described from another formation and whose stratigraphic range now includes the Reklaw, are as follows:

Orthoyoldia psammotaea vivianensis (Harris, 1919)
Tellina (Arcopagia) trumani, Harris, 1897b

Mathilda cf. retisculpta aldrichi Palmer, 1937
Bullia altilis harrisi Palmer, 1928
Cornulina cf. armigera (Conrad, 1833a)
Pleurofusia? huppertzi (Harris, 1895a)

Microdrillia rostratula Casey, 1903
Falsifusus ottonis (Aldrich,1886)
Ringicula trapaquara Harris, 1895a
Pyramidella (Cossmannica) perexilis (Conrad, 1865a)
Limacina cf. taylori (Curry, 1965)

Limacina augustana (Gardner, 1951)
Pseudoliva cf. santander Gardner, 1945
Athleta petrosa smithi Fisher and Rodda, 1964
Volutocorbis stenzeli Plummer, 1933

Stenzel (1953) reported a marine faunule from the Newby Member of the Reklaw in Cherokee County, which contained fish remains, molluscs, corals, bryozoa, and a sponge, without specifically identifying the fossils. The small pteropod mollusc, *Limacina stenzeli* Garvie *in* Hodgkinson *et al.*, 1992, mentioned and figured by Stenzel (1953, p. 82, fig. 42), and found by Stenzel in Cherokee County, is restricted to the Marquez Member. It occurs abundantly in all fossiliferous Reklaw sections examined in this report.

Apart from the molluscs I have also collected the following fauna from the Marquez Member:

Corals:
- *Turbinola sp.*
- *Endopachys* sp.
- *Paracyathus* 2 spp.
- *Madracis* ? sp.

Bryozoans:
- *Lunulites* 2 spp.
- Encrusting Bryozoan spp.

Annelids:
- *Surpula* sp.

Arthropoda:
- Carapace fragment of a crab, genus indet.
- Crab claw, genus indet.

Fish remains:
- Numerous spp. of shark and fish teeth
- Fish vertebrae and bones

Whale bones

Since the time of Penrose, very little has been written on the paleontology of the Reklaw. Plummer (1933) gives a short list of five species from the Colorado River valley, and a second list of 22 species

from the dump at the side of the "old Copper prospect", *cf.* locality 1. Some plant species are also listed from south Texas. Stephenson (1942, 1944) described ostracoda from the Reklaw in Ridge Creek, Bastrop County (*cf.* localities 2–6). Foraminifera are described by Bannahan (1950), Hussey (1951), and Davis (1961). Stenzel (1950, 1953), provided extensive geologic reports on areas with Reklaw deposits, centered in the Tyler Basin of East Texas. Professor F. E. Smith (oral. commun.) said the late Dr. F. E. Turner of Texas A&M University worked on the paleontology of the Reklaw. Hodgkinson *et al.* (1992) described many Reklaw pteropods in their monograph of the Eocene pteropods of the Gulf and Atlantic coasts. A site with abundant marine macrofossils occurs at a borrow pit exposing the Newby Sand Member in Rusk County, East Texas (*cf.*, locality 25).

STRATIGRAPHY

The Reklaw Formation was first recognized as a distinct unit by Wendlandt and Knebel (1929, pp. 1352–1355), and was described as "a basal layer, 20–40′ thick, of brown to dark blue, micaceous sandy clay; a middle layer, 4–15′ thick, of rather pure clayey glauconite containing plentiful fossils in the middle; and an upper layer of up to 100′ of brown clay with streaks of sand, green-sand, clay and clay-ironstone concretions". The type locality was given as the railroad cut in northeastern Nacogdoches County, 3.2 km (=2 miles) northeast of the village of Reklaw in Cherokee County. Stenzel (1939), in his work in Cherokee County, concluded that the lower 6–12 m (=20–40 feet) of the section graded laterally into, and interfingered with the Carrizo Formation. The middle 1.2–4.6 m (=4–15 feet) was named the Newby Sand Member and the upper 30 m (=100 feet) the Marquez Shale Member. Sams and Gaskell (1990), and Sams (1991) have examined the sequence stratigraphy of the Reklaw, showing the marine transgression occurred in repetitive stages of relative sea level rise. They also identify deepening marine sediments, culminating in a condensed section of 3–4.6 m (=10–15 feet), that has a maximum diversity and abundance of foraminifera.

In south Texas, Trowbridge (1923) named certain clay strata south of Carrizo Springs the "Bigford" and supposed them to be part of the Wilcox Group; near Carrizo Springs the Bigford apparently grades into the Carrizo. Gardner (1932), raised the Bigford to formation rank, separating it from the Carrizo. In recent years the term Bigford has fallen into disuse being assumed equivalent with the Reklaw. Stephenson (1953), in field work in East Texas, notes a ferruginous conglomerate, previously thought to be terrace deposits, giving evidence for it being possibly the basal bed of the Reklaw and overlying a possible eastern extension of the Bigford. During the field work fossils were found in the conglomeratic bed, and the underlying stratum, but were not well enough preserved to fix the stratigraphic age as Reklaw. Stephenson did note that the fossils appeared to be distinct, but had a general similarity to forms and faunas of the lower Claiborne Group. I examined the ferruginous conglomerate samples deposited at the Smithsonian Institution. A previous investigator had made rubber casts from the fossil molds. I examined these casts and several species were found to be specifically identical with species described later in this report from the Reklaw. Amongst the casts, were two diagnostic species, *Tritiaria nodosa* n.sp. and *Colwellia bilineata* n.sp., both so far restricted to the Marquez Shale Member of the Reklaw formation. No such wide-ranging conglomerate bed is mentioned in Sams and Gaskell (1990), although in Gonzales County Sams (1991, p. 153) described a similar pebble-moulded, hematite-cemented, sandstone bed in the Guadalupe River section.

Elisor (1929) traced the Reklaw into Louisiana and placed it below the Sparta Sand and above the Cane River Formation, while Hussey (1949), and Guevara and Garcia (1972), correlated the Reklaw with the lowest part of the Cane River Formation in Louisiana. Further east in Mississippi and Alabama the Tallahatta Formation is generally regarded as the equivalent of the Reklaw and Queen City formations. Gardner (1957, pp. 573–578) discussed the lithology and paleoecology of the Tallahatta formation exposed in Little Stave Creek, Clarke County, Alabama. In the region of the Rio Grande, the Reklaw (there regarded as equivalent with the Bigford) is approximately 213 m (=700 feet) thick, in Bastrop County—73 m (=240 feet) (Lyth, 1949), in Milam County—59 m (=195 feet) (Dunlap, 1955), in Robertson County—41 m (=133 feet) (Davis, 1961), in Leon County—30 m (=100 feet) (Stenzel, 1953), and in northern Cherokee County—27 m (=90 feet) (Stenzel, 1953). Within Milam County, Dunlap (1955) divided the Marquez Shale Member into three lithologic units; a lower crossbedded stratum of mainly carbonaceous shales containing sands and irregular concretionary layers; a middle evenly-bedded stratum of dark-green glauconitic fossiliferous shale; and an upper crossbedded stratum of shales with limonitic partings, iron-stone concretionary layers, and sand lenses.

A tentative correlation of the Reklaw with west coast faunas may be made via the foraminifera and calcareous nannoplankton zones. Hodgkinson *et al.* (1992, p. 9) noted that the Reklaw falls within the nannoplankton zone 13 as used by Dockery (1986). Of those foraminifera species which Davis (1961)

found restricted to the Reklaw, five were found by Weaver and Molander (1964) in the Eocene Cozy Dell or lower Sacate-Gaviota Formations of Santa Barbara County, California. These species are:

Anaomalina costiana Weinzierl and Applin
Cibicides sassei Cole
Haplofragmatoides cf. mauricensis Howe and Ellis
Robulus alato-limbatus (Guembel)
Trochammina claibornensis Howe

The only one of these not listed as rare is *T. claibornensis,* and it is restricted to the lower part of the Cozy Dell Formation. Weaver and Molander (1964) regard these two formations as Late Eocene (Narizian) in age, and approximately contemporaneous with the Domengine-Tejon Formations. Squires (1987, p. 8) cites literature which places calcareous nannoplankton zone 13, as being contemporaneous with the upper Carpay and lower Domengine molluscan stages.

The occurrence of the planktonic pteropod, *Limacina taylori* (Curry, 1965) in Taylor Branch (Hodgkinson *et al.,* 1992, p. 20) also establishes the Marquez Shale member to be contemporaneous with the lower part of the London Clay formation in England.

Other exposures of the Reklaw at Wolf Den Branch of Mud Creek, south of Franklin, Robertson County, and on the upper reaches of Threemile Creek, (*cf.* Smith, 1962, p. 9, stop 11 of the field trip guide), were investigated and with the exception of a few imprints of *Calorhadia* sp. in the ironstone beds of the creek near Franklin, and in the clays of Threemile Creek, were found to be nonfossiliferous. In the northeastern parts of Cherokee County, where Stenzel (1953) has described fossiliferous exposures from both the Newby and Marquez members, all the fossils localities in the Marquez Shale are leached, so that only imprints remain. The exposure in the Newby member mentioned by Stenzel (1953, p. 75) is now a very poor collecting site. To the west of Milam County, fossiliferous exposures are known from the Colorado River at several points, the first to be collected was known as Devil's Eye locality, 12.8 km (=8 miles) SE of Bastrop, Bastrop County, Texas. This locality produced the fossils described by Heilprin (1891), now in the Academy of Natural Sciences in Philadelphia.

The majority of specimens for this study came from Joe Taylor Branch (localities 12–22), and Ridge Creek (localities 2–7). Most of the exposures at these sites are sparingly but uniformly fossiliferous. Specimens tend to be very poorly preserved in the downstream part of the creek, owing to the permanently weathered condition of those exposures. Fossiliferous sediments in the Milam and Robertson County areas seem to be a local feature restricted to Joe Taylor Branch, the Bluff on the Brazos River just upstream of the mouth of the creek, and a small unnamed creek 1 km (=5/8 mile) upstream. In 1986 beavers invaded Joe Taylor Branch, and their resultant dams made collecting all but impossible, so Ridge Creek in Bastrop County was investigated in more detail. The beavers are no longer in evidence on Joe Taylor Branch, but it has never recovered its former productivity. Lyth (1949, p. 28, 35), noted well-preserved macrofossils from two exposures on Ridge Creek. Localities 3 and 4 were the site of very fossiliferous silty/sandy lenses and have produced the bulk of the specimens from this creek.

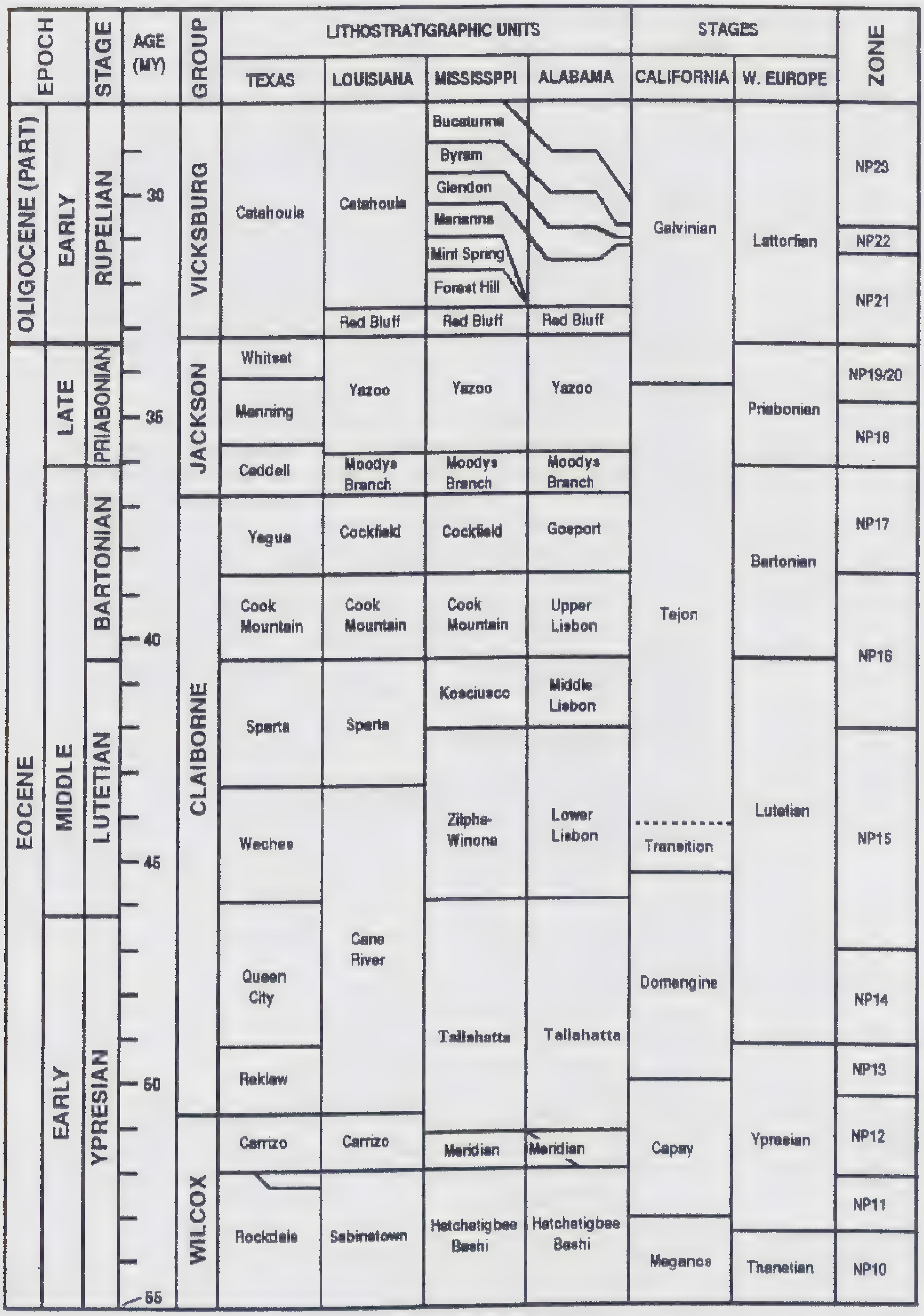
Most of the specimens were found concentrated in two depositional modes. The first mode is where specimens are found in thin, lenticular sandy lenses which appear to be storm deposits. The second mode where collecting is always good is a partially indurated glauconitic bed that marks the base of the unit B in Joe Taylor Branch. It is believed this thin glauconitic zone, easily recognized in the field, is the same zone that outcrops at the Colorado River banks at locality 7, and is also the same as bed 4c of Lyth (1949), in Ridge Creek. Bed 4c is about 3.4 m (=10 feet) above the Newby Marquez contact. It is not known if the Devil's Eye specimens examined in both the Academy of Natural Sciences in Philadelphia and in the Texas Memorial Museum derive from that same layer. Dumble (1892) described the strata at the Devil's Eye locality as follows: "The fossil-bearing bed is six to twelve inches thick, is semi-indurated, and composed almost entirely of glauconite and shells.", he also noted the same shell bed at Alum Bluff, at the mouth of Alum Creek, about 4.8 km (=3 miles) upstream of Smithville. None of the exposures examined for this report would appear to be as fossiliferous as those described by Dumble.

Measured Sections

Where applicable, the techniques described in Swanson (1981) were used as the basis for sample descriptions. As sections for Joe Taylor Branch have not been previously published, two typical ones are outlined in Text-figure 4, and explanations on the opposite page. Unit B containing the clay-ironstone layers can be readily followed from locality 15 to the mouth of the creek at locality 23, and can serve as a reference point for the sections. Lyth (1949), Sams and Gaskell (1990), and Sams (1991), may be consulted for a description of the Ridge Creek sections.

Locality Descriptions

Map references are in UTM metric grid notation on the relevant USGS topographic map.

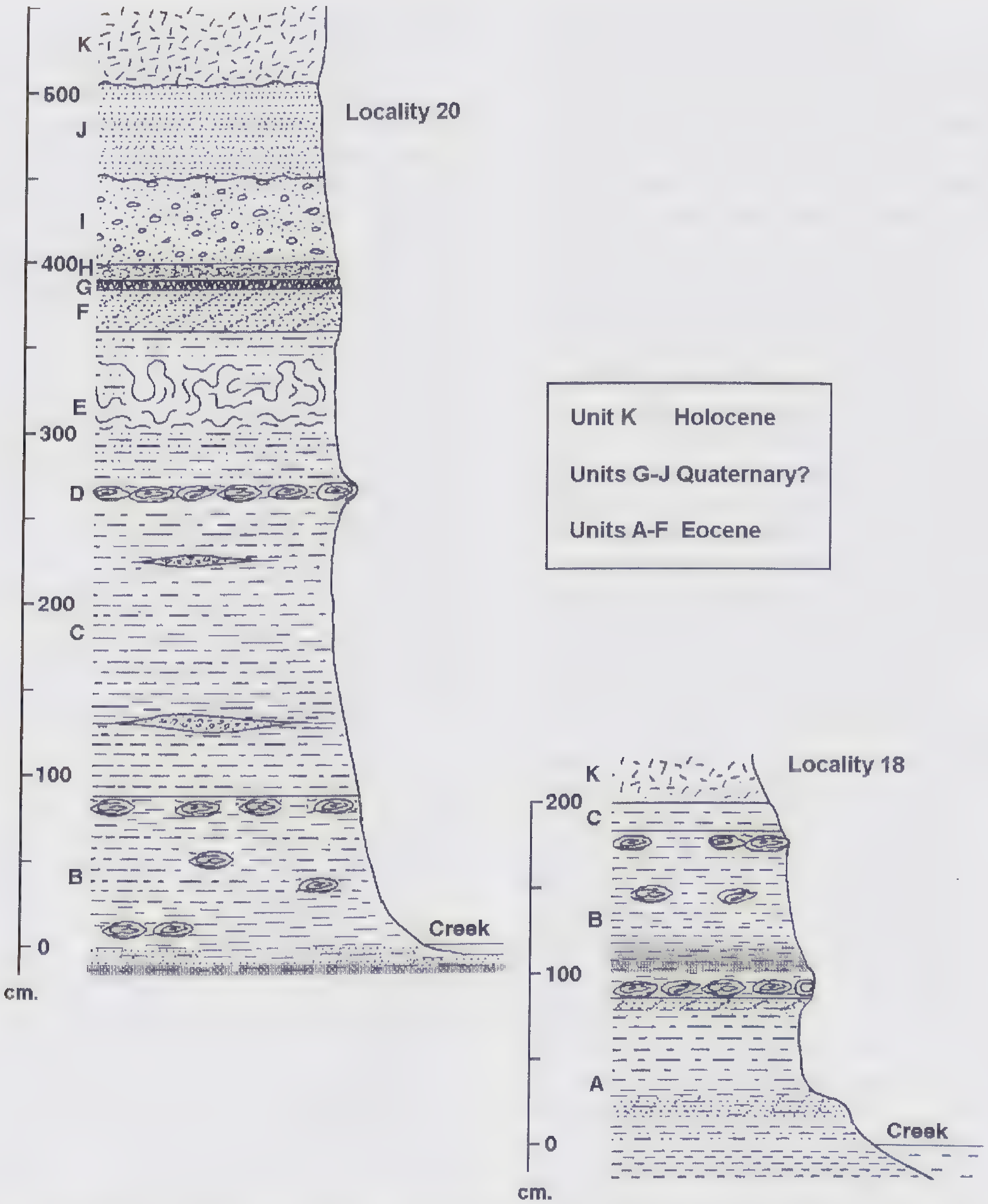


Text-figure 2.—Paleogene correlation chart of Eocene and some Oligocene standard ages and formations in the Gulf Coast, California and western Europe (from Toulmin, 1977, Nelms, 1979, Squires, 1987, Siesser, 1983, and Hardenbol, 1994).

Joe Taylor Branch composite section

Unit	Thickness (cm.)	Description
K		Soil.
J	91	White/light-gray, soft, calcareous sandstone conglomerate.
I	79	Partially cemented sandy conglomerate, brownish yellow in color.
H	8	Friable iron stained sand.
G	2.5	Highly weathered reddish/rust colored limonite deposited in contoured laminations.
F	23	Hard, conchoidally fracturing light-gray sandy siltstone with a few fine laminations and greater amounts of mica than the other units. Glauconite is absent or is only present as isolated grains. Abundantly fossiliferous especially at the base, where a layer of *Notocorbula* sp. occurs with a few larger forms such as *Bullia*, *Ancilla* and *Venericardia*. (Eocene)
E	91	Dark-brown sandy silt, finely laminated at the base (laminations ca.. 1 mm). Upper part micaceous, light yellowish-brown or gray, very sandy, with inclusions of umber-colored clays,and abundant patches of glauconite and areas of greensand. The central portion of this unit contains some highly contorted bedding with isolated patches of laminated silt within the upperpart, and similar isolated patches of greensand and glauconite below. The bed is fairly fossiliferous throughout the upper third with mollusks and corals. Concentrations of fossils are particularly abundant within the areas of greensand and glauconite. Common genera occurring here are *Athleta*, turrid gastropods and the coral *Paracyanthus*; most specimens showing signs of wear. Small subrounded pebbles up to pea size occur scattered throughout the upper third.
D	8-10	Reddish/orange, hard clay/ironstone ledge, or concretionary layer. Contains trace fossils of *Ophiomorpha*.
C	160	Gray to dark brown laminated micaceous mottled sandy silt. Yellow jarosite deposits are common on weathered surfaces. Occasional concentrated glauconite, otherwise isolated pellets of glauconite occur commonly. Some thin sand layers, in places indurated, packed with well-preserved mollusks, corals, bryozoans, fish remains, and occasional rounded pebbles and glauconite. The most common genera are: *Tritiaria, Colwellia, Athleta, Natica, Pyramidella,* turrid species, and *Limacina*.
B	97-112	Dark-gray, micaceous sandy clay, with several layers of light gray to rust-brown, discontinuous clay-ironstone, rarely also indurated sandstone ledges. The base of the bed is characterized by an almost continuous clay-ironstone layer, the upper ledges more lenticular and discontinuous. Above the lowest clay-ironstone layer is a dark-brown to greenish black, discontinuous, glauconitic, sometimes very fossiliferous layer, of maximum thickness 30 cm.; the fossiliferous sections of the glauconitic layer staining bright rust-red when weathering in the presence of moisture. At locality 20 the sandy clay contains several highly fossiliferous sandy lenses. The most common genera are: *Notocorbula, Athleta, Volutocorbis, Barbatia,* turrid species, and corals.
A	> 100	Hard, dark-brown to black silty finely laminated clays. Indurated, sometimes crossbedded lenticular, sand lenses common towards the top of the bed. Fossils occur very sparingly below the top of the bed.

Text-figure 3.—Explanation to profile of composite section on Text-figure 4.



Text-figure 4.—Profile of two localities in Joe Taylor Branch, Milam County, Texas. Source of many species described in the text.

Locality 1. (=TBEG 28-T-9) Dump by old copper mine shaft, E. Pullen survey, east of Sandy Fork Creek, 4.8 miles by road northeast of Harwood, Gonzales County. No trace remains in the fields of the mine or dump, which was apparently dug before 1933, and was an attempt to locate a treasure trove dating from Spanish suzerainty times. This is the type locality of *Turritella turneri* Plummer, 1933, and *Volutocorbis stenzeli* Plummer, 1933.

Localities 2 to 8 are along Ridge Creek (also known locally as Reed's Creek), 0.63 km (=1.0 mile) above the old Missouri, Kansas, and Texas railroad trestle and county road bridge, 10 km (=6.2 miles) west of Smithville, 1.3 km (=0.8) miles east of Upton, Bastrop County, Texas. Marquez member of the Reklaw Formation. Localities 2, 3, 4, and 6 were described by Lyth (1949).

Locality 2. (=Lyth, 1949, locality 4, map reference: ^{06}68.55E, ^{33}20.17N) Bluff on Ridge Creek, approximately 30.5 m (=100 feet) long exposed on north side of creek about 556 m (=1825 feet), (Lyth, 1949, in error says 825 feet) south of Missouri, Kansas, and Texas railroad trestle and county road bridge across Ridge Creek which is approximately 8.0 km west of Smithville or 1 km east of Upton.

Locality 3. (= Lyth, 1949, locality 5, map reference: ^{06}68.45E, ^{33}20.02N) Bluff on Ridge Creek, approximately 91 m (=300 feet) long exposed on the west side of the creek and about 730 m (=2400 feet) south of Missouri, Kansas, and Texas railroad trestle and county road bridge. The upper portion of the bluff has a very fossiliferous sandy lens, now obscured by slumping.

Locality 4. (= Lyth, 1949, locality 7, map reference: ^{06}68.40E, ^{33}19.92N) Bluff on Ridge Creek, approximately 61 m (=200 feet) long exposed on the west side of the creek and about 888 m (=2915 feet) south of Missouri, Kansas, and Texas railroad trestle and county road bridge. This is the site of the majority of the Ridge Creek specimens collected.

Locality 5. (Map reference: ^{06}68.43E, ^{33}19.67N) Bluff on north side of side creek which joins Ridge Creek about 970 m (=3180 feet) south of Missouri, Kansas, and Texas railroad trestle and county road bridge across Ridge Creek. This exposure had one fossiliferous silty lens which yielded most of the specimens of *Laevibuccinum lineatum* Heilprin, 1881. This was also the site of a large well-preserved, but flattened specimen of *Angulithes elliotti* (Stenzel, 1940), about 30 cm in diameter. This locality was not described by Lyth (1949).

Locality 6. (= TBEG 11-T-7, and Lyth, 1949, locality 6, map reference: ^{06}68.69E, ^{33}19.57N) Bluff on Ridge Creek, approximately 61 m (=200 feet) long exposed on the west side of the creek and about 3700 feet south of Missouri, Kansas, and Texas railroad trestle and county road bridge across Ridge Creek. This is the type locality of *Athleta petrosa smithi* Fisher and Rodda, *Angulithes elliotti* Stenzel, and *Aturia turneri* Stenzel. Only very leached sediments are exposed now.

Locality 7. (Map reference: ^{06}68.60E, ^{33}19.24N) Loose fossiliferous limonitic slabs in bed of Ridge Creek, about 1463 m (= 4800 feet) south of Missouri, Kansas, and Texas railroad trestle and county road bridge, and continuing upstream for about 305 m (=1000 feet) (not described by Lyth (1949). Due to vegetation cover, the level from which these slabs came was not ascertained but it appears to be near the very top of the formation. This exposure is the type locality of *Hexaplex eoa* n. sp., *Bittium ridgei* n. sp.

Locality 8. (=TBEG 11-T-72, Bombshell Bluff, map reference: ^{06}68.17E, ^{33}20.02N) Bluff on Colorado River bank, about 2.4 km (=1.5 miles) west-northwest of Devil's Eye, Bastrop County, Texas. High bluff along right bank of Colorado River, 0.63 km (=1 mile) east of Upton and .64 km (= 0.4 mile) east or downstream from the mouth of Ridge Creek, approximately 10.4 km (=6.5 miles) west of Smithville, Bastrop County, Texas. Marquez Member of Reklaw Formation. The bluff is no longer on the river but is at least 61 m (=200 feet) from the river, just downstream of a wooded island. Part of the bluff is still accessible and is very fossiliferous.

Locality 9. (Map reference: ^{06}68.17E, ^{33}20.02N) Outcropping gray indurated sandstone ledge on Colorado River bank, near water level, extending from just downstream of locality 8 for 61 m (=200 feet), Bastrop County, Texas. Large specimens of *Galeodea (Mambrina) turneri* Gardner, 1939, and *Clavilithes parvetorbis* n. sp. have been found here.

Locality 10. (=TBEG 11-T-35, map reference: ^{06}70.88E, ^{33}23.05N) Davids Bottom, left bank of Colorado River, 0.8 km (=0.5 mile) south of junction of Alum Creek and Little Alum creek, immediately south of dead-end gravel road leading to State Highway 71, Bastrop County, Texas. Marquez Member of the Reklaw Formation. The high river banks are now completely overgrown except for a glauconitic ledge seen only at very low river levels. The ledge extends upstream for some considerable distance.

Locality 11. (=TBEG 11-T-36) Devil's Eye, former island in Colorado river, 12.8 km (=8.0) miles southeast of Bastrop, between TBEG locality 11-T-39 (Kennedy Bluff) and TBEG locality 10. Marquez Member of the Reklaw Formation. Local recollection does not agree with the above description of Devil's Eye but rather with that of Penrose in: Dumble (1890, p. 30) which is described as: ". . . Devil's Eye, an eddy at a low ledge . . .". Nothing remains today of the "island" or low ledge in the river although the ledge can still be seen on the left bank.

Localities 12 to 23 are along banks of Joe Taylor Branch of Two Mile Creek[2]. 0.6 mile upstream from junction with Brazos River. 0.32 km (=0.2 mile) downstream from county road crossing of Two Mile Creek, southeast on county road 1.9 km (=1.2 miles) from U.S. Highway 79, at a point 6.2 km (=3.9 miles) northeast from the center of Gause; the point where the creek crosses the county road is given by U.S.G.S. Gause quadrangle topographic map, reference 96 deg. 39′ 06″ N, 30 deg. 48′ 40″ E. Marquez member of Reklaw formation.

Locality 12. (Map reference: ^{07}24.40E, ^{34}10.76N) Hard black silty clay in bed and banks of Joe Taylor

[2] Localities 12 to 23 were measured and described in 1985 and as such due allowance must be made for changes in the intervening time. For example, the author has photographs documenting 12 m of erosion at Joe Taylor Branch creek at Locality 20 in ten years.

creek, just downstream of county road bridge to 0.9 m (=3 feet) resistant ledge. The banks of the creek have produced irregular echinoids.

Locality 13. (Map reference: [07]24.33E, [34]10.90N) Banks of creek and small waterfall on small side creek 46 m (=150 feet) upstream of junction with Joe Taylor Branch creek, just below locality 13. This locality has produced fine examples of *Phalium (Semicassis) reklawensis* n. sp.

Locality 14. (Map reference: [07]24.52E, [34]10.79N) Banks and bed of Joe Taylor Branch creek, from base of 0.91 m (=3 feet) resistant ledge to first bend, a distance of about 244 m (=800 feet). The bed of the creek produced the large *Galeodea (Mambrina) turneri* Gardner, 1939, figured in Plate 14. The right hand creek banks contain stringers with micro-gastropods, one of which contained numerous specimens of *Ringicula cf. trapaquara* Harris, 1895, and *Solariorbis? parsnaticoides* n. sp. At the downstream end of this locality, vertebrae and other bone material of a whale were collected, now deposited at the J. J. Pickle (formerly the Balcones) Research Center, University of Texas at Austin.

Locality 15. (Map reference: [07]24.31E, [34]10.69N) Hard glauconitic lenticular fossiliferous ledge at right hand bank of Joe Taylor Branch creek at water level. This exposure is the source of many large *Barbatia* spp.

Locality 16. (Map reference: [07]24.36E, [34]10.67N) Large low ledge at sharp bend of Joe Taylor Branch creek, and below a source of water seepage. Unit B of this locality was the site of some remarkably fossiliferous lenses and was notable for large *Athleta petrosus smithi* Fisher and Rodda, 1964, *Protosurcula? aurora* n. sp., and other large turrid species. The downstream end of this exposure (unit B) is the source of a poorly preserved crab carapace.

Locality 17. (Map reference: [07]25.40E, [34]10.71N) Left hand bank of Joe Taylor Branch creek, from just upstream of small waterfall over a limonitic ledge to just downstream of intermittent flowing gully, a distance of 15 m (= 50 feet). No large fossils have been found here, but unit A has sandy layers very rich in pteropod species.

Locality 18. (Map reference: [07]25.43E, [34]10.76N) Banks of Joe Taylor Branch creek about 152 m (=500 feet) long ending at a high cliff on the left bank where the creek enters an open flat area. At the base of a very overgrown bluff are localized and sometimes lenticular sandy zones in the clay, just underneath a sometimes discontinuous limonitic ledge about 1.2 m (=4 feet) above water level. These are locally very fossiliferous and have produced almost all the *Michela trabeatoides carinata* n. subsp. specimens found in the Reklaw.

Locality 19. (Map reference: [07]25.57E, [34]10.76N) High cliff, about 61 m (=200 feet) long on right hand side of Joe Taylor Branch creek, just downstream of a dry branch. Bed B near the end of the exposure has produced a few larger molluscs. From the description, this would also appear to be locality TBEG 165-T-3 (cf. text-figure 4).

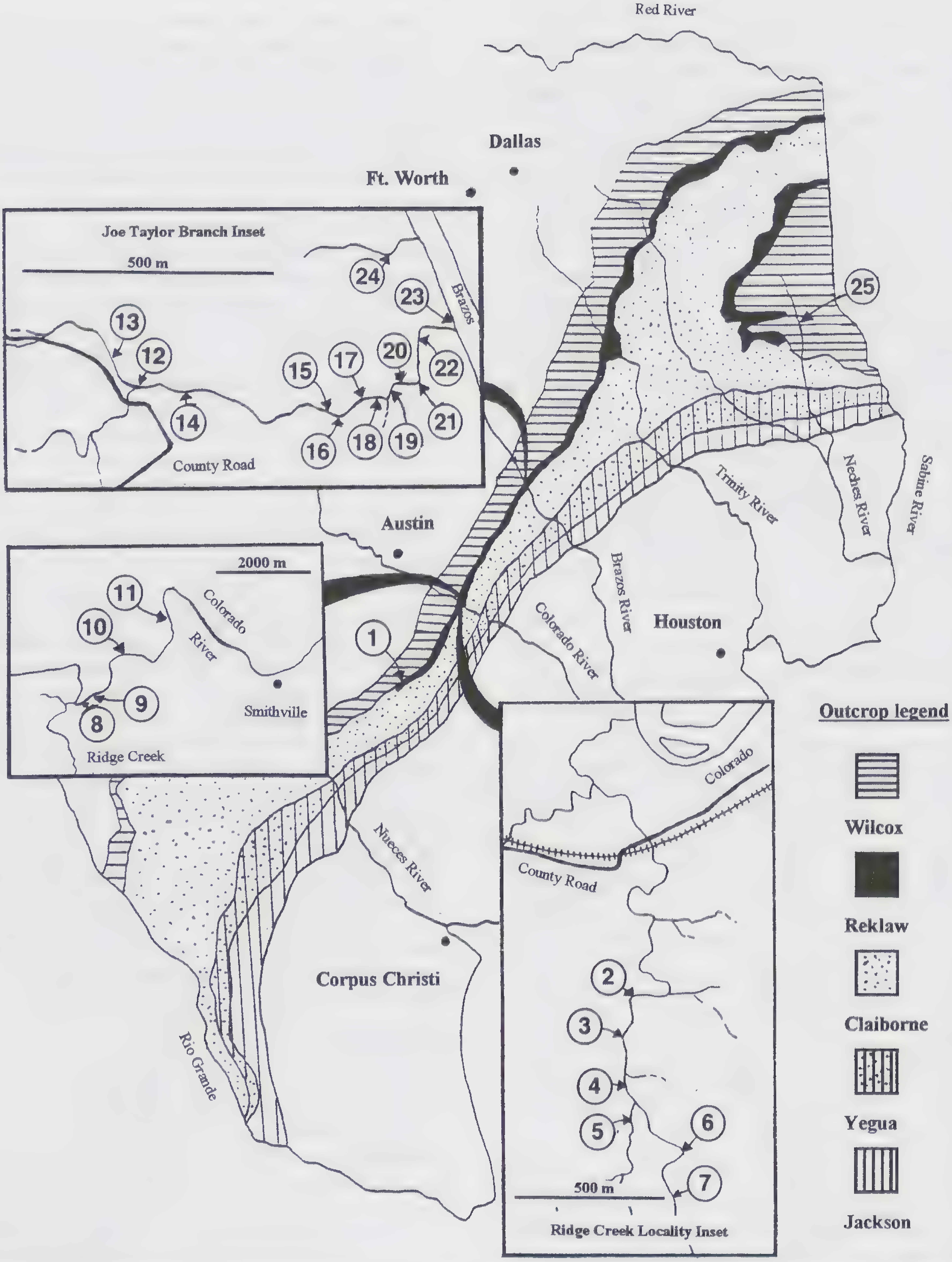
Locality 20. (Map reference: [07]25.62E, [34]10.86N) High cliff at left side at sharp bend of Joe Taylor Branch creek. The vast majority of fossils found from Joe Taylor Branch creek came from this exposure and most of those from two very fossiliferous lenses, one in bed B just above water level and the other about 6 ft above the base of unit C. Unit F which is first exposed at this locality, is traceable until the end of locality 21, and is also the source of many unique or only rarely found species such as *Buccinanops ellipticum reklawensis* n. subsp., *Strepsidura harrisi* Givens and Garvie, and *Venericor densata reklawensis* n. sp. The base of unit B at the very end of the exposure is the source of numerous specimens of *Pseudoliva cf. santander* Gardner. Unit E is notable for occasional large *Architectonica (Stellaxis) reklawensis* n. sp., and numerous specimens of corals (*Paracyathus* sp.).

Locality 21. (Map reference: [07]25.71E, [34]10.95N) Long high cliff with initial left hand bend on Joe Taylor Branch creek, ending at small rapids and scree of limonitic boulders. Beds A through K of locality 21 are traceable through this area with a noticeable decrease in sand content and increase in glauconite. The base of unit B has produced the only specimens of *Clavilithes parvetorbis* n. sp. and *Fusinus claibornica* n. sp. found from this creek. Unit B at the downstream end is the site of a large mass of rolled coral and within it the specimens of *Cypraeorbis bulbus* n. sp.

Locality 22. (Map reference: [07]25.74E, [34]11.09N) Small 1.5 m (= 5 feet) high bluff on right bank of Joe Taylor Branch creek, about 90 m (= 300 feet) downstream from the end of locality 22, ending the Reklaw exposure before its reappearance at the mouth of the creek at locality 24.

Locality 23 (Map reference: [07]25.83E, [34]11.12N) High bluff on left bank just before the mouth of Joe Taylor Branch creek, and high bluff on right bank of Brazos River. Numerous specimens of a *Paracyathus* coral species. The base of the bluff at low water level has a discontinuous layer of nuculanid bivalves. I have not seen this exposure in an unweathered state.

Locality 24. (Map reference: [07]25.57E, [34]11.40N)



Text-figure 5.—Maps showing the extent of the Reklaw Formation in Texas (after Collins, 1980, and Sams and Gaskell, 1990) and fossil locations discussed in the text.

Banks of a small unnamed creek entering the Brazos River about 1 km (=5/8 mile) airline distance upstream of the mouth of Joe Taylor Branch creek. The creek side exposures are similar to unit E of locality 20, but even more sparingly fossiliferous.

Locality 25. (=TBEG 200-T-1) Borrow pit on north side of U.S. Highway 84 near east bank of Angelina River, 300 feet west of the river, 4.2 km (=2.6 miles) east of Reklaw, Rusk County, Texas. Newby and Marquez members of the Reklaw Formation. See Stenzel (1953, p. 60, fig. 31) for a detailed section of this locality. The locality is now very weathered but still collectable. The oyster *Hyotissa offemanae* n. sp. is the most common large mollusc present.

COLLECTION AND PREPARATION OF SPECIMENS

Only where sediments were continuously wet were fossils found washed free or observed in situ; on other exposures weathering leaches the fossils from the sediments. With even moderate weathering, the fossiliferous layers become highly indurated, iron-stained and the fossils corroded. Generally, fresh specimens are very fragile, particularly from the sandy lenses in Joe Taylor Creek, the original shell material being partially leached and in many cases secondary calcium carbonate has re-deposited as crystalline growths on the specimens and within the matrix.

As most fossils are fragile, extreme care is required in cleaning and removal of adhering matrix. The process of alternate washing, drying and sieving so useful in disintegrating the shales of the Stone City member and Cook Mountain formations, produces a shell hash of broken, or distintegrated material when applied to the Reklaw fauna. Many of the rarer and unusual specimens were cleaned under 10 or 20 power magnification of a binocular microscope. On many of the highly ornamented forms, adhering grains of sand had to be removed singly using the point of a needle to avoid damaging the specimens. The calcitic crystalline growths, which on gastropods were most commonly cemented to the apex and apertural region and in bivalves to the hinge area, could be removed by careful scraping with a sliver of a razor blade.

A weak solution of cellulose acetate in acetone was frequently used to harden shell surfaces; repairs were made with cellulose acetate cement. As can be seen from a number of figures, in spite of the greatest care, breakage of specimens was common.

DEPOSITIONAL ENVIRONMENT

The sedimentary characteristics at locality 20 are varied: regions of clayey silt alternate with finely laminated sands, glauconite and greensand layers, and the boundaries are often disrupted by contorted bedding, possibly produced by subaqueous slumping. In general the micaceous sediments of unit C are poorly laminated and finegrained. Interspaced within the silts are thin shell-rich layers, containing corals, bryozoans, molluscs, and fish remains. Crossbedding and ripple laminations were not observed. The only mollusc that might indicate fluviatile conditions would be *Theodoxus,* but modern representatives of this genus also live in marine environments.

The condition of the fauna within the shell layers suggests a transported or winnowed assemblage; the bioclasts are mixed and reach a maximum size of about 3 cm. The preservation of the fossils is excellent; even highly ornamented species such as *Chama* and *Volutocorbis* are perfectly preserved and broken or abraded specimens are rare. Moreover, the interior of many gastropods is hollow and some have a brown flakey organic looking substance in the aperture. Within the spire of one specimen the carbonaceous material reached almost to the apex, was not attached to the interior wall and looked very like the dried body of the animal. Several specimens were analyzed at the Electron Microscopy Laboratory at Arizona State University, and Dr. L.A.J. Garvie (pers. comm.) reported the interior substance was almost pure amorphous carbon with other elements below the threshold of detection. If the molluscs were buried with the soft tissues intact, that would indicate a rapid burial. Epifaunal bivalves are almost invariably found disarticulated, in one sample of more than 200, only 5 were found with both valves united.

The sedimentary conditions of unit E suggest a higher energy environment than for the other beds. Fossils and areas of greensand are intermingled, the fossils often broken, and usually extensively abraded. The central part of the bed clearly shows considerable contorted bedding. Bioturbidation was not observed, and in any case is unlikely to account for the large-scale mixing, as the intermixed zones are typically much larger than the fossils. The areas of greensand have the same fauna found in the shell layers, although more sparsely distributed, and generally the specimens are larger. Subangular quarzite pebbles up to 1 cm. are not uncommon in this bed.

Unit F is a fine sandy silt with abundant *Notocorbula* and *Caryocorbula* occurring in the lower part; the lower boundary clearly indicating deposition by currents, as all the scaphopods are aligned parallel to one another. The beds above unit F are eroded away at locality 20, but may be observed both up and downstream of this locality.

COMPOSITION OF THE FAUNA

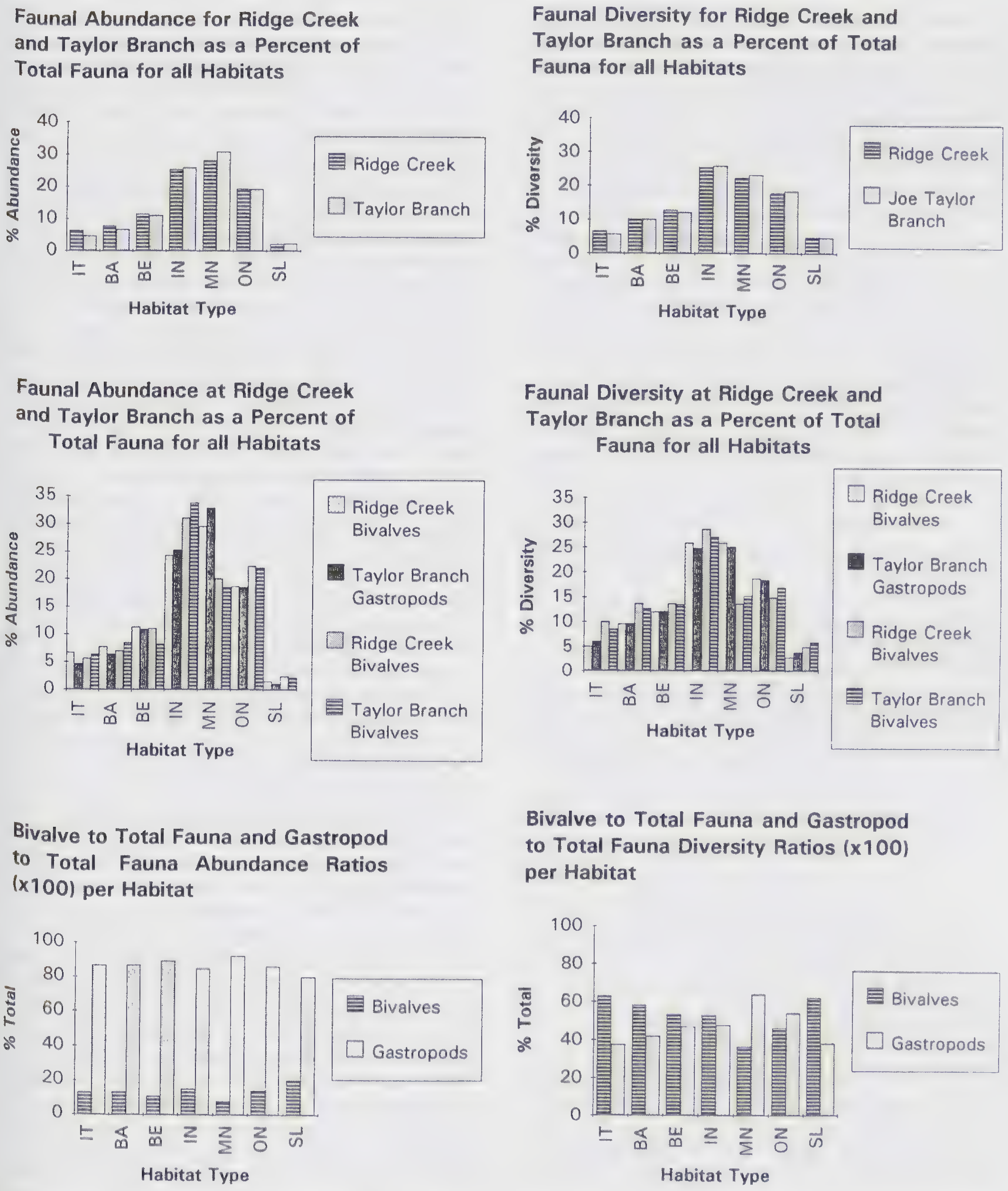
Table 1 (inside back cover) lists the fauna from the two localities where the majority of the collecting was done, **TB**: Joe Taylor Branch (= localities 12–22), and **RC**: Ridge Creek (=localities 2–7). The codes within the latter two columns indicate, a: abundant (100+ specimens), c: common (11–100), u: uncommon (6–10), r: rare (1–5). The habitat is gleaned from various sources, primarily L. Smith (1959, 1962, 1965), Hulings (1955), Natland (1957), and Abbott (1974), and is intended as an indication only. Following Smith the marine environmental continuum is subdivided into the following six habitats:

Inside intertidal (IT):	river channel near mouth; inside beach and marsh, shallow depth; brackish
Bay and pass (BA):	occasional salinity reduction, combined brackish and marine or transitional faunas
Beach (BE):	essentially zero depth to approximately 3 m (=10 feet); normal marine
Inner neritic (IN):	approximately 3 m (=10) feet to approximately 30 m (=100 feet); normal marine
Middle neritic (MN):	approximately 30 m (=100 feet) to approximately 90 m (=300 feet); normal marine
Outer neritic (ON):	approximately 90 m (=300 feet) to approximately 180 m (=600 feet); normal marine
Slope (SL):	shelf edge to continental rise; open sea

The habitat of the many species with no modern relatives was inferred from taxa with similar shell form. Text-figure 5 displays the result of distributing 5125 specimens from Ridge Creek and 3700 specimens from Taylor Branch within the seven habitat types as given in table 1. All complete specimens found during the duration of the study were kept, broken specimens were also kept of the rarer species. The fauna collected is therefore likely to be a good approximation of the original fauna after taphonomic processes. The numerical count of a species was equally distributed between habitat types when more than one habitat was inferred. The computed faunal abundance histogram should be similar in shape to the orginal faunal abundance histogram in the seven habitats, although the computed values would be less than the original values, due to the bias of not collecting all of the original sample. The collection error is unlikely to significantly change the overall shape of the graph, given that the same bias applies to all seven habitats. The diversity count sums the number of different species and subspecies assigned to each habitat; if more than one habitat was inferred a count of one was equally distributed as a fractional value between the habitats. The difference in total diversity and abundance distributions between Ridge Creek and Taylor Branch is very small considering the number of individuals involved, implying a very similar set of environments at the two locations. More than 75% of the fauna is similar to taxa living in the inner neritic to outer neritic habitats with a diversity maximum at the shallow inner neritic. Interestingly, the maximum abundance is in an inferred environment of 30–90 m (=100–300 feet) greater depth than the diversity maximum. Bivalves make up about 12% of the total fauna and gastropods about 88%. In contrast the bivalve and gastropod diversity ratios (counting species and subspecies) are in an inverse relation to each other with a turning point at the middle neritic habitat.

These habitat data support the case for the majority of the fauna being an open marine assemblage, although some current winnowing must have taken place to produce the size-limited specimens in the shell seams. The excellent condition of the shells also implies a low energy depositional environment, although a rapid burial appears likely given the evidence that some molluscs appear to show the fossilized soft-bodied animal remains. Perhaps the animals were killed by a load of fine mud from a land runoff, or river sediment, causing the burial. The sediments within the units where the shell seams are common often show a fine component of plant material indicating a landward origin. A supporting piece of evidence is the appearance of the usually fluviatile genus *Theodoxus*, it could also have been transported seaward with the land or river sediments.

Hickman (1976, p. 25–28) cites studies noting the increasing percentage of turrid species in modern neogastropod faunas with depth. Within the Reklaw fauna the turrid percentage of the fauna is about 26%, placing the bulk of the Reklaw faunas in the 0–20 m range, although probably at the deeper end since the turrid families represented are indicative of deep water (Hickman, 1976; Powell, 1966). The presence of abundant corals, bryozoans and bivalve suspension feeders also implies that the fauna must have lived in a normal marine environment. Purdy (1964) notes that suspension feeders are more common in sands, while *Nucula, Glycymeris, Chama* and *Postalia,* prefer a coarser substrate such as gravel, or shell hash, or a reef substrate. As the bulk of the Reklaw material is found within a sandy clay it might indicate some transportation of the material took place prior to final disposition. When bivales such as *Chama,* and *Plicatula* that prefer a hard



Text-figure 6.—Charts showing the relative abundance and diversity of species found in Ridge Creek and Joe Taylor Branch, and their inferred environment.

substrate have been found attached, they are always attached to a branching coral or serpulid gastropod mass, all of which usually shows signs of wear. All the *Cypraeorbis* species were found associated with rolled coral fragments, while the two complete specimens were embedded in very large masses of coral as though broken off from a reef. Several bivalve genera could indicate deeper water, notably *Hyotissa, Amusium,* and *Bathyarca,* although all of them are uncommon or rare in the Reklaw deposits. In conclusion it appears that most of the Reklaw fauna was deposited in an inner to middle neritic, 3–30 m, setting, with a component derived from a nearby reef. This setting is corroborated by Sans and Gaskill (1990) who find that the foraminiferal diversity maximum occurs at the top of a condensed section, and correlates with a maximum marine flooding surface. The inferred environment is a very shallow marine to marginal marine environment which deepens to an open-marine inner neritic setting.

Repository Abbreviations

In the systematic section the following codes are used:

ANSP	Academy of Natural Sciences in Philadelphia, PA, USA
AMNH	American Museum of Natural History, New York, NY, USA.
USNM	United States National Museum, Washington, DC, USA
PRI	Paleontological Research Institution, Ithaca, NY, USA
TBEG	Bureau of Economic Geology, Austin, TX, USA
UT-TMM	Texas Memorial Museum, Austin, TX, USA (repository of the type specimens of the Bureau of Economic Geology, Austin, Texas).
BMNH	Natural History Museum, London, England.

SYSTEMATIC PALEONTOLOGY

Introduction

For specific comparisons, the publications of previous workers on the Paleocene faunas such as Conrad, Lea, Harris, Aldrich, and Palmer, etc. were used and then in most cases verified by comparison with the holotype. With very few exceptions all dates and citations were verified by checking the original reference; those few that could not be verified are noted in the text. Not all *nomen translatum* and *nomen correctum* items have been verified for family and higher taxa.

The classification followed is that of Haszprunar (1988) for the archeogastropods with modifications by Dockery (1993); Ponder and Warén (1988) is followed broadly for the Caenogastropoda, Heterostropha and Euthyneura; Moore [Editor], (1964, 1969, 1971) for the Bivalvia and Cephalopoda; Steiner (1992) for the Scaphopoda.

Gastropods are described in the traditional North American orientation with the apex up (dorsal) and the aperture below (ventral). Morphological terms applied to gastropods are those defined in Moore (1960, p. I129–I135). Following Stenzel *et al.* (1957), bivalves are described with orientation of the hinge above and the commissure below; and the length as "the greatest dimension obtained by projecting the end of the shell onto the line of the hinge axis"; the height as "the greatest dimension obtained by projecting the umbonal region and the ventral margin onto a line at right angles to the hinge axis and within the plane of symmetry"; the width of a shell as "its greatest transverse dimension, generally the width of one valve is half the width of the whole shell". Remaining bivalve morphological terms and hinge-tooth notation are those used in Moore (1969, p. N56, pp. N102–N109). Scaphopods are described following Hodgkinson (1974), with the aperture anterior, apex (with smaller diameter than the anterior end) posterior, and the ventral face (line of maximum diameter) down.

Where species belong to new genera not found in the Gulf Coast and are clearly different from any previously known they were assigned a new taxon without hesitation. For the bulk of the species though, there are known related Sabine or Claibornian forms. The variability of the group could be ascertained either from Museum collections or the author's own collection. If a Reklaw species differed significantly in one or more primary characters from a similar species, it is usually defined as a new species. A primary character is used in the sense of what the original author, and any succeeding revisors, regarded as of primary importance in the definition of the taxon. For example, if a particular species was defined as always having two columella plications, and if all specimens of a similarly appearing Reklaw species had only one, then that would be a candidate for a new taxon. If, however, the Reklaw species had several more spiral lines on the whorls than a similar, but already known species, less weight would be given to that character if it was not constrained by the original author or revisors in some way. What constitutes a specific difference is of course subjective, especially for fossil faunas, and in fact is not even consistent from group to group. I have attempted to separate each group in the Reklaw fauna, using the same degree of variability for that group as

already defined in the recent literature. In that task I have been particularly guided by how Palmer (1937), Harris (1937), Harris and Palmer (1946–1947), and Stenzel *et al.* (1957) treated the groups. If a subset of a species exhibits a character or characters that is not one of the primary ones, and yet shows consistent differences from the s.s. set, that subset is a candidate for a new subspecies. The same considerations apply when deciding whether a new genus should be defined, except in this case, I have been particularly influenced by how Wenz (1933–1944), Zilch (1959–1960), and Thiele (1931) have defined the generic groups. If a more recent treatment of the group in question exists that was also consulted. A question mark after a generic citation indicates that the species assigned to that genus differs, but not markedly so, in a primary character from the type species of that genus, or, that a primary character cannot be seen in the specimen due to breakage, or, because attached matrix obscures the feature. Question marks within synonymies are used in the same sense as used in Palmer and Brann (1965–1966).

For most taxa a large number of specimens was available for study, in the hundreds for some of the more common taxa. In a few cases new taxa are described from a small number of specimens, a practice not usually recommended, but in those cases the Reklaw taxa usually belonged to genera either not known in the Sabinian or Claibornian stages, or where one or more primary characters showed considerable differences from the most similar taxon.

One general problem that has to be dealt with when considering the Reklaw faunas is the question of size. This is considered in two parts: The first part considers those Reklaw species that come from what is regarded as an open marine environment. This would include the section from the base of the Marquez Shale Member to the top of the condensed section of Sams and Gaskell (1990). Subjectively, the Reklaw species would appear to be much smaller than that of similar Claibornian or Sabinian species. When comparisons are made between species for which large collections are available (for instance *Athleta, Ancilla,* and several turrid genera), the maximum size of the comparable species is usually between half and three-quarters of the maximum of the species from the other stages. The average size of the species collected from the Reklaw fauna appears to be significantly smaller than average sizes collected from the other stages. Part of this result is believed to be due to a collection bias. Within the Claibornian stage, fossils can be collected on the outcrops with ease, so the smaller specimens may be overlooked or not collected to the same degree as the larger ones. Within the Reklaw outcrops, the fossils are comparatively rare, so all specimens tend to be collected, regardless of size. Size has therefore rarely been used as a differentiating character in the comparisons of taxa between the stages. The second part is for those sections where Sams and Gaskell (1990) inferred the depositional environment as transitional to brackish water. This includes localities 6 and 7 where the size differences are much more pronounced than in the marine sections. Only one large species has been found here, a large *Venericor* clam, the remaining species are much smaller than comparable species from the open marine beds. Due to the different environment, size is regarded as a significant factor for species restricted to these beds.

When comparisons are made between gastropods, the number of whorls rather than size is used in inferring whether the specimen is a juvenile or adult. When comparing bivalves or scaphopods there is no equivalent easy way to distinguish the juveniles from species that are small in the adult stage. For some bivalves (for instance the nuculanids), the outline changes as the shell transitions from the juvenile to the adult, and that can be used to distinguish growth stages. For many bivalves (for instance corbulids and some venerids), where similar genera exist in the Sabinian and Claibornian stages, juveniles and adults were available for comparison, and growth stages could be inferred. For the scaphopods, the prominence of the apical notch in the family Gadillidae can indicate the growth stage, for other families the size must be relied upon.

Unless otherwise noted, the repository of all specimens noted in the *Material examined* sections, is in the author's collection. Type and most figured material is in PRI. Some extra material from the type series will also be deposited in the USNM and BMNH.

SYSTEMATICS

Phylum **MOLLUSCA** Linnaeus, 1758, p. 641

Class **BIVALVIA** Linnaeus, 1758, p. 669

Subclass **PALAEOTAXODONTA** Korobkov, 1954, p. 72

Order **NUCULOIDA** Dall, 1889a, p. 450

Superfamily **NUCULOIDEA** Gray, 1824, p. 241

Family **NUCULIDAE** Gray, 1843, p. 155

Genus **NUCULA** Lamarck, 1799, p. 87

Type species.—Arca nucleus Linnaeus, 1758, by monotypy. Recent in European seas.

Diagnosis.—Shell small, nacreous, trigonal to subcircular, inequilateral, anterior end longer than posterior; area behind umbo slightly to strongly depressed; two sets of chevron-shaped, close-set hinge teeth, the

anterior set the larger; external surface generally smooth or concentrically striated; valve margins usually finely crenulate.

Remarks.—The genus is recorded from the Cretaceous onwards; recent representatives are deposit feeders and are found in both shallow and deep waters, both in sandy and mud substrates; the species is more characteristic of boreal and temperate waters. At least 21 species are recorded from the Paleocene and Eocene of the Gulf Coast.

Nucula cochlear, new species
Plate 1, figures 1–4

Description.—Shell very small, long and ovately elliptical. Width about 53% of length and 67% of height. Umbones at 80% of length, lying posterior to the middle; a low rounded ridge extends from there to the posterior extremity. A weak concavity is developed dorsally to the ridge, the valve margin where the ridge terminates is rounded and has an angular change of about 130°. The ventral margin is smoothly rounded with about eight crenulations per mm Lunule narrow, bordered by a low, rounded ridge, escutcheon lanceolate, poorly defined and moderate in size. Hinge line smoothly curved and hinge plate possessing about 17 anterior and nine posterior, long, slightly curved teeth. Resilifer concave, oblique towards the anterior margin and jutting downward. Pallial line indistinct, sinus sharply triangular with the apex pointing vertically upward. Sculpture of indistinct rounded undulations and radial lines, both becoming obsolete on the umbo.

Remarks.—Allied species are *Nucula (Nucula) mauricensis* Harris, 1919 from the Weches and Stone City formations, and *Nucula (Nucula) smithvillensis* Stenzel and Twining, 1957 from the Weches Formation; *N. mauricensis* is more inflated, has a smaller lunule and has the anterior and posterior hinge dentition meeting at an acute angle; *N. smithvillensis* is more elongate, less inflated, has a more pronounced umbonal ridge and shows no sign of any concentric sculpture.

Etymology.—The specific name refers to the large spoon-shaped resilifer which is uncommonly large for the genus.

Type information.—Holotype: left valve, PRI 30260; paratype: right valve, PRI 30261. Type locality: locality 20.

Material examined.—31 specimens, largest 6.1 mm long, 4.8 mm height, 1.7 mm width. Mean ratios: height/length .27, width/height .34, umbones/length .8.

Nucula spp.

Remarks.—Two further species of *Nucula* appear to exist in the Reklaw deposits. One of them is very much larger than *Nucula cochlear* n. sp., with a length of up to 10 mm It could be a gerontic specimen of that species but is uniformly ribbed over the entire dorsal surface and is more extended; both specimens of this species are badly crushed and preserved in a block of matrix from which they are impossible to remove. The second species is represented by one broken specimen which is much higher, has more prominent hinge teeth and is less elongate than *N. cochlear.* Neither of these two species can be further characterized until better material is obtained.

Superfamily **NUCULANOIDEA** H. and A. Adams, 1858, p. 544

Family **NUCULANIDAE** H. and A. Adams, 1858, p. 546

Genus **NUCULANA** Link, 1807, p. 155

Nuculana Link, 1807 (=*Leda* Schumacher, 1817, p. 173).

Type species.—Arca pernula Muller, 1771, by monotypy. Recent in North Polar seas and in the North Atlantic.

Diagnosis.—Shell moderately high, rostrate, with slightly anterior umbones and obtuse posterior keel, surface with concentric ornament. Lunule long, very thin, and sharp-ridged, escutcheon obscure, ligament pit very small and produced posteriorly, pallial sinus usually present.

Remarks.—Stewart (1930), stressed the importance of the small asymmetric chondrophore inclined posteriorly along the compressed series of taxodont teeth in the recognition of this genus. As with all Nuculanidae this is a deposit feeder.

Subgenus **JUPITERIA** Bellardi, 1875b, p. 20

Type species.—Nucula concava Bronn, 1831, by subsequent designation (Dall, 1898, p. 579). Pliocene of Italy.

Diagnosis.—"Shell small corbuloid, strongly inflated, subequilateral, bluntly rostrate, rostrum barely ridged; area behind umbo flattened but not depressed; sculpture consisting of obscure concentric rugae; hinge consisting of an anterior and posterior set of chevron-shaped teeth, approximately equal in length; chondrophore small, triangular, deep; pallial sinus shallow, the apex bluntly U-shaped." (Woodring, 1925, p. 18).

Remarks.—The subgenus has been recognized in the Paleocene of the S.E. and S. United States, the Pliocene and Miocene of Europe, and Recent in the West Indies.

Nuculana (Jupiteria) turgeo, new species
Plate 1, figures 13–16

Description.—Shell very small, height about 62% of length, strongly inflated, thickness 32–39% of

height and umbones almost median at 42–50% of length. Anterior end smoothly rounded, posterior end very feebly rostrate; anteriodorsally rounded and with a slight indentation ventral to the rostrum. Lunule narrow, sunken and long, escutcheon lanceolate, margined by a rounded angulation and containing a medial line. About 15 posterior and 13 anterior chevron-shaped teeth. Pallial line indistinct, sinus broad, U-shaped and moderately deep. Posterior end with two rostral rays extending from the umbo to the limits of the rostrum. Surface smooth, shining and with irregular concentric incremental threads, obsolete anteriorly and posterior-medially then stronger again between the rostral rays.

Remarks.—This species combines some of the characteristics of both *Ledina* s.s. and *Calorhadia* s.s. The general shape with the rounded ends and smooth exterior places it near to *Nuculana (Jupiteria) smirna* (Dall, 1898) of the Kincaid Formation of Texas and the Wills Point Formation of Alabama, and *Ledina sp.* Harris and Palmer 1946 (p. 60, pl. 14, figs. 9–11) of the Jackson Group. Some specimens have a faint nacreous sheen internally. The shape of *N. (J.) turgeo* is similar to that of *Calorhadia houstonia* (Harris, 1895a) of the Cook Mountain Formation; however, the latter species is about twice the size, and possesses several short, radial lines near the rostrum. *N. (J.) turgeo* can also be distinguished from those similar forms by a strong inflation, shorter form and poorly rostrate outline. The rostral ridge varies from being well-defined and rounded, to being essentially obsolete. Two other similar genera which might be considered for this assignment are *Saccella* Woodring, 1925, and *Portlandica* Mörch, 1857. *Saccella* has a pointed rostrum and concentric folds, while *Portlandica* is more rostrate, has a heavier shell, and a shallow pallial sinus.

Etymology.—The specific name *turgeo* (Latin, swollen), refers to this species' very inflated form.

Type information.—Holotype: right valve, PRI 30262; paratypes: left valve, PRI 30263, double valve, PRI 30264. Type locality: locality 20.

Material examined.—55 specimens, the largest: 3.2 mm length, 2.0 mm high, 0.8 mm width. Mean ratios: height/length .62, width/height .35, umbones/length .48.

Subgenus **SACCELLA** Woodring, 1925 p. 15

Type species.—*Arca fragilis* Chemnitz, 1784 (= *Leda commutata* Philippi, 1844a), by original designation.

Diagnosis.—Shell small, high, slightly inequilateral, posterior end rostrate, pointed and unicarinate; umbo more or less central, a shallow groove extends from the umbo to the ventral margin at both ends of the valve; sculpture consists of strong concentric rugae; anterior and posterior series of teeth are approximately equal in length; apex of pallial sinus broadly U-shaped.

Remarks.—Palmer and Brann (1965), list seven species from the Paleogene of the Gulf and East Coast of the U.S. The subgenus appears to be uncommon in the Clairbornian of Texas with the exception of the Weches Formation. It is widely distributed today.

Nuculana (Saccella) demissa, new species
Plate 1, figures 9–12

Description.—Shell very small, moderately inflated, height about 58% of length, umbones central. Anterior end smoothly rounded, posterior end rounded in young shells, feebly rostrate and ending in a blunt point in older ones. Lunule narrow, not well defined, escutcheon wider, bordered by a rounded ridge which ends at a rostral point, and containing another ridge running parallel to the margin for three-quarters of the length. About 16 posterior and 12 anterior chevron-shaped teeth. Surface smooth on the anterior third, ornamented medially with low and rather large concentric rounded folds which then become indistinct on the posterior third of the shell.

Remarks.—This species is easily distinguished from the only other similar Reklaw species *Nuculana (Jupiteria) turgeo* by its concentric folds. Larger specimens show a shallow depression in front of the rostral ridge running from the umbo to the ventral margin, while on the posterior side a smooth radial ray is formed by the cessation of the central folds. The comparatively large folds concentrated in the middle third of *N. (S.) demissa* can also distinguish this species from other Paleogene species. In outline, *Nuculana (Saccella) catasarca* (Dall, 1898) from the Cook Mountain Formation of Wautubbee, Mississippi, approaches this most closely although it is a very much more inflated species. This species has only been found in the indurated ledge at the top of the formation. The species may appear to be very small, and juvenile in aspect, but several adult species figured by Moore (1983, pl. 2) are within 1–2 mm of the size of *N. (S.) demissa.*

Etymology.—Referring to the low and indistinct character of the folds.

Type information.—Holotype: left valve, PRI 33070; paratype: left valve PRI 33071. Type locality: locality 7.

Material examined.—Four specimens, the largest, 4.2 mm length, 2.5 mm height.

Genus **LITORHADIA** Stewart, 1930, p. 37

Type species.—*Leda acala* Dall, 1898, by original designation. Bashi Formation, Sabine Group, Eocene of Alabama.

Diagnosis.—Resilifer narrow, oblique; posterior end

produced; sculpture smooth or concentric; lunule sunken; ligamental pit wide; pallial sinus wide.

Remarks.—Gardner (1945), noted further the absence in *Litorhadia* of the posterior end double carination, and the obsolete or obtuse concentric sculpture so sharply developed in the group typified by *Calorhadia pharcida* (Dall, 1898). The group is particularly well developed in the Eocene of the Gulf Coast and is abundant at most of the Cook Mountain Formation localities in Texas. The genus ranges from the Eocene into the Miocene.

Litorhadia milamensis, new species
Plate 1, figures 5–8

Description.—Shell small, elongate, height 47–57% of length, umbones at 39–45% of length, inflation moderate at 25–43% of height. Anterior end smoothly rounded, posterior end produced and rostrate, the rostrum obliquely truncate. Umbones opisthogyrate, the dorsal margin from the umbones to the anterior end straight to feebly medially angulated, escutcheon and lunule long, the lunule bounded by a rounded angulation and bisected by a sharp ridge. Posterior portion of the valve bounded by two further rostral ridges. The inner surface of the valve with a rounded ridge, parallel to the dorsal margin and terminating in a prominent knob under the rostrum. Umbones with very fine concentric sculpture which disappear after about 1 mm and then reappear again more prominently with about ten undulations per mm.

Remarks.—This species can be distinguished from the other Reklaw species by the fine regular folds and narrow interstices. Gardner (1927), described the species *Leda atakta* from the Weches Formation at Smithville, referred to *Saccella* by Palmer and Brann (1966), and which shares many points of similarity with *Litorhadia milamensis.* This species appears to be the direct descendant of *L. milamensis* and is separated from it by its shorter, plumper form and larger flat and smooth inter-rostral area.

Etymology.—The specific name *milamensis* refers to Milam County.

Type information.—Holotype: right valve, PRI 30265; paratypes: left valve, PRI 30266, juvenile left valve, PRI 30267. Type locality: locality 20.

Material examined.—20 specimens: the largest 6.7 mm length, 3.4 mm height, 1.3 mm width. Mean ratios: height/length .52, width/height .34, umbones/length .44.

Litorhadia undulata, new species
Plate 2, figures 1–4

Description.—This species, which has a generally similar outline to *N. (J.) turgeo* n. sp., can be distinguished by its more rostrate outline, the surface ornamentation of low rounded folds which become sharper towards the ventral margin and interstices wider than the folds. The folds die out irregularly towards the anterior end and sharply before a concave area preceding the first ventral ray.

Remarks.—This is the most common of the Reklaw *Litorhadia* species. Imprints referrable to this species have also been found in the ironstones of Wolf Den branch of Mud Creek, Robertson County, and Three Mile Creek in Milam County, Texas. The external ornamentation is so strikingly similar to those of *Nuculana jewetti* (Gardner, 1927) from the Weches Formation (not Cook Mountain Formation as given by Palmer and Brann, 1965, p. 219), that this species is undoubtably the precursor of Gardner's species. *N. jewetti* is shorter, lacks the concave area preceding the rostral ray and has a flat posterior ventral margin, not concave as in *Nuculana milamensis.* The folds of *L. undulata* vary quite considerably in size and at one extreme, approach the size of those of *L. milamensis.* The distinguishing feature is that the folds of *L. undulata* are the same size at all stages of growth while in *L. milamensis* the folds increase slowly in size with increasing growth. Worn specimens from Ridge Creek in Bastrop County possess the same outline as typical *L. undulata* from the type locality, although the surface ornamentation is finer and more effaced. None however has the fine regular pattern of *L. milamensis.*

Etymology.—The specific name *undulata* (Latin, wavy) refers to the prominent surface undulations.

Type information.—Holotype: left valve, PRI 30268; paratype, right valve: PRI 30269. Type locality: locality 20.

Material examined.—90 specimens: the largest 8.3 mm length, 4.6 mm height, 1.0 mm width. Mean ratios: height/length .55, width/height .22, umbones/length .44.

Litorhadia valdefragilis, new species
Plate 2, figures 5–8

Description.—Shell very small, inflated, elongate, height 43–50% of length, umbones anterior at 35–40% of length. Outline of dorsal margin from umbo to tip of rostrum curved. Posterior rostral rays defined by two smooth diverging lines, the anterior ray defined by a slight swelling on the surface. Adult specimens have the anterior margin of the rostrum thickened into an elongate boss which projects into the interior past the hinge line. Resilium small and recessed. Lunule very feebly defined to absent, escutcheon long and lanceolate. Sculpture of well-defined rather widely-spaced, raised, concentric lines, the interstices with exceedingly fine lines of growth. The concentric lines are

obsolescent before the anterior ray, and on the posterior end before the first rostral ray; the lines of growth continue undiminished in character over the rays.

Remarks.—The fine evenly-spaced concentric lines and the smooth rostral rays immediately distinguish this species from *Litorhadia undulata* and *Litorhadia turgeo.* The closest described relative is probably *Litorhadia? bastropensis* (Harris, 1895a) from the Weches Formation; *L. bastropensis* has concentric lines with wider interstices. . The species is more common than the recovered number of specimens would indicate but the extreme fragility of the shells accounts for its apparent rarity. The fine sculpture sets this species apart from known Nuculanidae of the Eocene of the Gulf Coast. I have found a similar, although smoother species in the Stone City Member that appears to be the descendant of *L. valdefragilis.* Even though the larger specimens of *L. valdefragilis* are still very small, they do not appear to be juveniles. Adult specimens of *Calorhadia* and *Litorhadia* are more elongated than the juvenile ones, because the rostrum in the adult specimens is much more developed. Specimens of *L. valdefragilis* greater than 2 mm in length have essentially the same proportions, suggesting they have reached their adult proportions.

Etymology.—The specific name *valde* (Latin, very much), *fragilis* (Latin, easily broken), refers to that feature of the shell.

Type information.—Holotype: left valve, PRI 30270, right valve, PRI 30296. Type locality: locality 5.

Material examined.—19 specimens, the largest 4.0 mm length, 2.0 mm height.

Litorhadia sp.
Plate 1, figure 17

Remarks.—Two specimens were obtained of a *Litorhadia* which is quite distinct. It possesses folds of the type found in *Litorhadia milamensis* but only over the anterior quarter of the shell, the rest of the surface being smooth with indistinct irregular undulations. The specimens are cemented in a block of matrix so the interior cannot be observed.

Figured specimen: A left valve, PRI 30552, from locality 12.

Material examined.—2 specimens, the largest 7.2 mm length.

Genus **ORTHOYOLDIA** Verril and Bush, 1897, p. 55

Type species.—Yoldia scapina Dall, 1889b, by original designation. Recent off the Brazilian coast.

Original diagnosis.—"Shell oblong, gaping, blunt or rounded at both ends, without distinct rostrum; no carina. Pallial sinus large and broad. Teeth numerous in both series. *O. scapina* [error for *scapinia*] (Dall) from off Brazil, and *O. salenoides* (Dall), from the West Indies." (Verril and Bush, 1897, p. 55).

Remarks.—A reasonably common genus in the more unctuous shales of the Cook Mountain Formation, and Stone City Member beds of Texas, but difficult to collect due to their fragility. The genus is known from the Eocene onwards. Recent species are deposit feeders and primarily boreal in their distribution.

Orthoyoldia psammotaea vivianensis
(Harris, 1919)
Plate 2, figures 9–10

Yoldia psammotaea var. *vivianensis* Harris, 1919, p. 73, pl. 25, fig. 31.

Orthoyoldia psammotaea vivianensis (Harris). Stenzel, Krause and Twining, 1957, p. 55.

Original diagnosis.—". . . The variety "*vivianensis*" has much more prominent beaks and stronger sculpture than *psammotaea*. . . ." (Harris, 1919, p. 73).

Remarks.—The Reklaw specimens have about 22 anterior and 20 posterior teeth, compressed and chevron-shaped near the beaks and becoming spatulate and compressed parallel to the hinge towards the posterior end. Resilifer deep, widely triangular and set back beneath the hinge line. Surface sculpture of concentric lirations, 12–14 per mm., strong medially and indistinct at each end. The subspecies is only known from the Reklaw Formation in Texas and Louisiana.

Type information.—Holotype: PRI 4231, an external mold in ironstone showing the shape and some details of the sculpture. Type Locality: Reklaw Formation of Vivian, Caddo Parish, Louisiana. Figured specimen: PRI 30271, from locality 20.

Material examined.—12 specimens, the largest: 11.5 mm length, 5.5 mm height, 1.0 mm width, umbones/length .41.

Subclass **PTERIOMORPHIA** Beurlen, 1944, p. 144

Order **ARCOIDA** Stoliczka, 1871, p. xx

Superfamily **ARCOIDEA** Lamarck, 1809, p. 318

Family **ARCIDAE** Lamarck, 1809, p. 318

Subfamily **ARCINAE** Lamarck, 1809, p. 318

Genus **BARBATIA** Gray, 1840, p. 81

Type species.—Arca barbata Linnaeus, 1758, by subsequent designation (Gray, 1847a, p. 197). Recent in the Mediterranean.

Diagnosis.—Shell usually moderate to large in size, somewhat irregular in outline; moderately inflated; anterior end rounded, posterior end rounded or angulated with a keel; posterior slope rounded; byssal gape

small. Sculpture usually of beaded radial ribs. Umbones anterior. Cardinal area narrow with five or more chevron-shaped ligament grooves; hinge straight; hinge teeth continuous in the young, separated by an edentulous gap in the adult. Ventral valve margin finely crenulated. Periostracum hairy.

Remarks.—Recent species are suspension feeders, most abundant in warmer seas ranging from the intertidal zone to abyssal depths; shallow water representatives are usually attached by a byssus. The genus ranges from the Jurassic to Recent.

Subgenus **ACAR** Gray, 1857, p. 369

Type species.—*Arca gradata* Broderip and Sowerby, 1829, by subsequent designation (Woodring, 1925, p. 37). Recent off the coast of Mexico and Central America.

Original diagnosis.—"Shell small to medium sized, trapezoidal in outline, posterior end keeled; byssal gape narrow; sculpture coarsely reticulate and imbricate; ligament area rhombohedral and for the most part opisthodetic; teeth like those of *Barbatia* s.s. but the anterior series is larger" (Gray, 1857, p. 369).

Remarks.—The genus is known from the Paleocene to Recent. Living members of this subgenus are restricted to tropical and subtropical waters. Palmer and Brann (1966), note only two in the Paleogene of the Gulf Coast.

Barbatia (Acar) salebrosus, new species
Plate 2, figures 11–12

Description.—Shell elongate, medium in size, height 23% of length, umbones anterior at 26% of length, flattened and slightly inrolled behind the hinge line. Hinge straight with six anterior and ten posterior teeth. Anterior dorsal margin rounded, ventral margin sinuous, concave medially and anteriorly, gape shallow, posteriorly regularly rounded. Sculpture of thick concentric very regular foliations, covered by radiating costae which are thickened and upturned at the end of the foliations. Posterior umbonal region delimited by a slightly thickened line of nodular costae. Umbonal slope sculpture of hook-shaped downturned costae, the entire surface additionally covered with raised lines forming a granular effect. Interior with low radial and concentric undulations corresponding to the external sculpture. Adductor muscle scars elliptical and elevated, edge flattened and crenate.

Remarks.—Only one species referable to section *Acar* is reported from the Gulf Coast, viz. *Barbatia (Acar) aspera* (Conrad in Wailes, 1854); that species ranges from the Middle Eocene Weches Formation through the Upper Eocene Jackson Group. The present species seems to be the precursor of *B. (A.) aspera,* but differs enough to warrant separation from it. *B. (A.) aspera* has a sharper umbonal ridge with a very noded summit, a concave post umbonal area, and little or no medial depressed area. A possible antecedent is a variety of *Barbatia cuculloides* (Conrad, 1833a) found at Bell's Landing, which has a somewhat similar although weaker sculpture, is more regular and has a weaker umbonal ridge than the Reklaw specimens.

Etymology.—The specific name *salebrosus* (Latin, roughness), refers to the rough external sculpture.

Type information.—Holotype: a right valve, PRI 30272, 14.2 mm in length. Type locality: locality 15.

Material examined.—Two specimens, the largest 19.0 mm length, 10.0 mm height (estimated), 6.0 mm width. Two further fragments were also obtained.

Subgenus **CUCULLAEARCA** Conrad, 1865a, p. 11

Type species.—*Byssoarca lima* Conrad, 1847, by subsequent designation (Stoliczka, 1871, p. 340). Lower Oligocene, Vicksburg Group, of Mississippi..

Diagnosis.—Elongate to obliquely subquadrate, subequal but generally much distorted, ventral valve margin deeply sinuated by a large byssal gape; cardinal area high, amphidetic; sculpture formed by fine to coarse subequal costae; hinge long, straight, teeth in continuous series in young, in adults divided in the middle by large gape, distal teeth conspicuously larger and oblique.

Remarks.—The subgenus ranges from the Upper Cretaceous to Recent. Living members of the subgenus live in warm seas.

Barbatia (Cucullaearca) reklawensis, new species
Plate 2, figures 13–14

Description.—Shell medium in size, height 60% of length, width 33% of height, umbones anterior at about 29% of length. Shape obliquely rhombohedral, larger posteriorly. Anterior end obliquely truncate at the ventral margin, rounded medially and truncate at the intersection with the straight hinge line. Posterior end rounded to produced medially. Posterior keel not noticeable, ventral margin concave at both ends, convex in the middle at the byssal gape. Sculpture consists of coarse concentric growth-resting stages crossed over by numerous ribs which on the umbo tend to bifurcate, wider on the posterior end, fine medially and somewhat larger again anteroventrally. Posterior umbonal region sharply delimited by one larger coarsely foliated rib, the sculpture more subdued on the umbonal slope than on the rest of the shell.

Remarks.—The holotype is 36 mm long, 22 mm in width and 8 mm height; four juvenile specimens were also recovered, the largest 19 mm in length. Height/length, width/height and umbones/length ratios were

within 10% of each other for all specimens. This species differs from *Barbatia uxoripalmeri* Stenzel and Krause, 1957, in its flatter and more rhombohedral shape, the straight hinge line and the more subdued ornamentation. The coarse rib separating the concave umbonal slope from the rest of the sculpture is very reminiscent of genus *Arca* and this species has some characteristics of both genera. Juvenile specimens show little trace of the expanded umbonal rib, the areas delimited instead by a sharper angular change in the shell. One specimen was also found in the Newby member in Cherokee County, at locality 25.

Etymology.—The specific name *reklawensis* refers to the formation.

Type information.—Holotype: a right valve, PRI 30273; paratype: a juvenile left valve: PRI 30274. Type locality: locality 15. Paratype from locality 20.

Material examined.—14 specimens, the largest: 36.0 mm length, 22.0 mm height, 8.0 mm width, 10.0 mm umbonal length. Mean ratios: height/length .59, width/height .35, umbones/length .29.

Barbatia sp.
Plate 2, figure 15

Description.—One specimen obtained, in hard sandstone, of a *Barbatia* species whose rhomboidal outline is similar to that of *Barbatia rhomboidella subscopula* (Harris, 1919) from the Lisbon Formation. The specimen is very finely ribbed with 54 ribs, those on the medial and posterior area bifid.

Type information.—Figured specimen: PRI 30305, from locality 8, length:13.5 mm.

Genus **BATHYARCA** Kobelt, 1891, p. 213–214

Type species.—Arca pectunculoides Scacchi, 1834 by original designation. Recent in European Seas.

Diagnosis.—Shell minute, subglobose, inequivalve, left valve larger than right. Posterior carina obscure or lacking. Sculpture of radial costellae and concentric threads, slightly different on each valve. Ligament area narrow, hinge line straight, teeth short and oblique, posterior and anterior series separated by an edentulous gap. Margin of valve faintly fluted.

Remarks.—The genus ranges from the Eocene to recent with the living species confined to relatively deep water. All but a very few species are minute in size.

Bathyarca claibornica, new species
Plate 3, figures 1–4

Description.—Shell very small, asymmetrical, to 3.5 mm in length, highly inflated, hinge line about 80% of maximum length. Sculpture of fine radial gently rounded costae, the intercostal area with a fine sharp radial line; overriding the radial sculpture are fine concentric lines which bend towards the umbo as they cross over the costae, stronger over the area which is transitional to the weak umbonal slope; sculpture of the left valve slightly more prominent than the right. Cardinal area under the umbones margined by a smoothly curved line; ligament preserved as a small asymmetrical high triangle, the base of which defines the edentulous portion of the hinge line. Teeth eight or nine in number on the anterior side and six on the posterior side. Inner margin of valves coarsely crenate.

Remarks.—This species is unique in the American Eocene, the oldest previously described form being *Bathyarca hendersoni* (Dall, 1898) from the Bowden beds in Jamaica. The largest specimen, unfortunately broken after collection, was 3.5 mm in length. All remaining specimens are 2 mm or less in size. Cossmann suggested that *Arca lissa* Bayan, 1873, from the Lutetian of the Paris Basin was an ancestral Eocene *Bathyarca*; the Reklaw species is much closer to the holotype than that species.

Etymology.—The name notes the first occurrence of this genus in the American Claibornian.

Type information.—Holotype: a left valve, PRI 30275; paratype: a right valve, PRI 30276. Type locality: locality 20.

Material examined.—17 specimens. Maximum length, 3mm. Mean ratios: height/length .8, width/height .44, umbones/length .67.

Family **NOETIDAE** Stewart, 1930, p. 78

Subfamily **TRINACRIINAE** MacNeal, 1937, p. 458

Genus **PACHECOA** Harris, 1919, p. 46

Type species.—Trinacria (Pachecoa) cainei Harris, 1919, by monotypy. Middle Eocene, McBean Formation of Orangeburg, South Carolina.

Diagnosis.—Shell small, moderately to strongly inflated; oval, trigonal or cunate-rectangular, not gaping. Umbones median or closely so, opisthogyrate. Anterior smoothly rounded, posterior usually angular, rostral ridge well developed. Lunule not present, escutcheon very narrow. Hinge arcuate, anterior series of teeth usually slightly longer than the posterior set. Cardinal area small and elongate-triangular, situated entirely behind beaks, ligamental area elongate, oblique and anterior to beak. Sculpture of low concentric ribs and close-spaced radial ribs. Inner margins crenate or smooth.

Remarks.—Stenzel *et al.* (1957, pp. 61–65) give a detailed discussion on the validity of the name *Pachecoa.* The genus is restricted to the Eocene of the Gulf and Atlantic Coasts.

Pachecoa concentrica, new species
Plate 3, figures 7–10

Description.—Shell small, to about 4 mm in length, moderately inflated, cuneate-rectangular, umbones slightly anterior. Anterior and ventral margin smoothly rounded, posterior-dorsal margin nearly straight. Umbonal ridge rounded, the umbonal area flat towards the dorsal margin. Anterior teeth seven, posterior series five or six. Sculpture of low somewhat irregularly spaced concentric rounded ribs, radial sculpture almost entirely obsolescent, defined principally by a microscopic wrinkling on the margins of the ribs, slightly stronger on the umbonal slope. Inner margins of valves smooth.

Remarks.—This species is smaller than other species of *Pachecoa* and differentiated further by the obsolete radial sculpture and smooth inner margins of the valves. It appears to be the ancestor of *Pachecoa sabinica* (Harris, 1919), a higher and more triangular species with well defined radial and concentric sculpture and crenate valve margins. Both Lower Eocene representatives of this genus, *Pachecoa decisa* (Conrad, 1833b) "var." Clark and Martin, 1901, and *Pachecoa microcancellata* (Barry, 1942), have smooth inner valve margins. Another species from the same time interval is the Tallahatta species *Pachecoa (Pachecoa) catonis* Stenzel and Twining, 1957, from Alabama; this species is larger, has about twice the number of hinge teeth and has both radial and concentric threads generating a reticulate pattern on the main part of the disc.

Etymology.—The name *concentrica* notes the dominant character of the sculpture.

Type information.—Holotype: a left valve, PRI 30277; paratypes: PRI 30278, 30279. Type locality: locality 20.

Material examined.—23 specimens, the largest: 4.1 mm length, 3.1 mm height, 1.0 mm width. Mean ratios: height/length .76, width/height .32, umbones/length .41

Superfamily **LIMOPSOIDEA** Dall, 1895, p. 517

Family **GLYCYMERIDIDAE** Newton, 1922, p. 72

Subfamily **GLYCYMERIDINAE** Newton, 1922, p. 72

Genus **GLYCYMERIS** da Costa, 1778, p. 168

Type species.—Glycymeris orbicularis da Costa, 1778, by original designation. Recent, widely distributed in shallower waters of warm and temperate seas.

Diagnosis.—Shell heavy, equivalved, equilateral or subequilateral, suborbicular. Beaks almost straight or only very slightly incurved; hinge margin arcuate with two series of transverse teeth; ligament amphidetic. Exterior surface of valves concentrically or radially striate; valve margins crenulate; adductor scars almost equal.

Remarks.—Members of the genus are cosmopolitan in distribution and range from the Lower Cretaceous to Recent. Recent species are suspension feeders and often well adapted to life in a shell hash or gravel bottom environment.

Glycymeris sp.
Plate 3, figures 5, 6

Description.—Shell small, 6 mm., orbicular and dorsally very slightly trigonal. Beak very feebly prosogyrate, ligamental area small, at about 23% of length, triangular, with a few chevron-shaped grooves. Hinge highly arcuate with about eight teeth on either side. Outer surface very worn but still showing fine closely spaced radial lines.

Remarks.—The only complete valve obtained is apparently a left one but is very worn and is therefore not named specifically. The closest relative would seem to be *Glycymeris trigonella* (Conrad, 1833c) from the Gosport Sand of Alabama, a species of the same size but with a more circular outline.

Figured specimen: PRI 30280, from locality 20.

Material examined.—One specimen: 6.5 mm length, 6.5 mm height, 1.9 mm width.

Order **MYTILOIDA** Férussac, 1822, p. xvii

Superfamily **MYTILOIDEA** Rafinesque, 1815, p. 147

Family **MYTILIDAE** Rafinesque, 1815, p. 147

Subfamily **MYTILINAE** Rafinesque, 1815, p. 147

Genus **MYTILUS** Linnaeus, 1758, p. 704

Type species.—Mytilus edulis Gray, 1847a, by original designation. Recent in the North Atlantic.

Diagnosis.—Shell mytiliform, beaks terminal, lunule with radiating folds forming dysodont teeth on the anterior margin. Anterior retractor scar elongate, behind the umbo, anterior adductor small but distinct; margin not crenulate. Surface smooth or with radial ribs which are not bent in the dorsal direction.

Remarks.—The genus is known from the Upper Jurassic to Recent, and is cosmopolitan in distribution. The preferred habit of living members is colonial, attached with a byssus to rocks and seaweeds.

Subgenus **CRENOMYTILUS** Soot-Ryan, 1955, p. 23

Type species.—Mytilus grayanus Dunker, 1853, by original designation. Recent in the Indo-Pacific.

Diagnosis.—"Shell mytiliform with terminal umbones, lunule grooved and incurved, forming two or

three large teeth usually obsolete in old specimens. Margins finely crenulated. Shell obliquely striated, especially distinct on the ventral surface. Resilial ridge compact; anterior adductor strong, showing a distinct thickened scar; anterior retractor scar elongate behind umbo; posterior adductor and retractor scars continuous." (Soot-Ryan, 1955, p. 23).

Remarks.—Several species are known from the Oligocene to Pliocene of the west coast of America. Only one recent species is known, *Crenomytilus grayanus* (Dunker, 1853), from the Philippines.

Mytilus (Crenomytilus) sp.
Plate 3, figures 13, 14

Description.—Shell moderate in size, smooth, brown in color. Dorsal area above the line defining the position of maximum inflation with faint radial lines, the remainder smooth except for lines of growth and shell thickenings which reflect growth resting stages. Margin of the valves minutely crenulated except near the umbo where a few larger teeth occur. Ligament a thin groove under the teeth on the anterior-ventral margin.

Remarks.—Mytilidae are not common in the Gulf Coast Eocene, only one species, *Hormomya hamatoides* Call, 1891, being described so far. The present species fits readily in *Crenomytilus* with the crenate edge and compact linear ligament area. Another species with crenate valve margins that may be superficially confused with a juvenile *M. (Crenomytilus)* sp. is *Crenella isocardioides* (Lea, 1833). This species is much smaller, thicker-shelled, lacks terminal umbones, and has typically one weak, projecting cardinal tooth.

Figured specimen.—A double valve, PRI 30281, from locality 4.

Material examined.—One partially crushed double valve specimen, 9 mm length.

Subfamily **CRENELLINAE** H. and A. Adams, 1857, p. 514

Genus **GREGARIELLA** Monterosato, 1883, p. 90

Type species.—*Modiolus sulcatus* Risso, 1826, by original designation. Recent from the Mediterranean.

Diagnosis.—Elongate species with anterior umbones, straight dorsal margin, angulated umbonal keel separating a coarsely sculptured dorsal part from a smoother ventral part. Radially striate or decussate anteriorly or posteriorly where the posterior striae end along an oblique line. Hinge with dysodont teeth both anteriorly and posteriorly, valve margins dorsally finely crenulate. Periostracum hairy with bifurcating hairs.

Remarks.—Members of this genus reportedly live in burrows in shell and coral. The genus is known from the Eocene to Recent.

Gregariella ridgei, new species
Plate 3, figures 11, 12

Description.—Shell very small, elongate rounded-subrectangular, dorsal side almost straight, ventrally with a shallow sinus, translucent brown in color, the prodissoconch whitish and sharply defined from the teleoconch. Sculpture of bifurcating radial lines covering the surface from the dorsal margin, to below the umbonal angulation, there covering about one quarter of the ventral slope. Radial lines overriden by incremental co-marginal growth lines and occasional undulations, stronger on the dorsal slope, there forming a latticed pattern. A few weak radial lines are seen again on the smooth ventral slope in the immediate neighborhood of the umbo. On the ventral slope the radial striae end in an irregular, more or less oblique line. Resilium elongate, relatively large, posteriorly with four or five larger teeth, anteriorly and beneath the umbo three larger teeth and a few smaller ones. Valve margins crenulate except above the resilium. Anterior muscle scar compressed-elliptical, the end situated directly under the beak, posterior scar bean-shaped and very indistinct.

Remarks.—This species is similar to *Gregariella arcaforma* H. E. Vokes, 1986, a species from the Miocene Chipola Formation of Florida. The Chipola species is two to three times the size, more modioliform and more evenly rounded at the anterior end than *G. ridgei.* This is the earliest report of the genus in America. Glibert and van de Poel (1965, p. 80), who treat *Gregariella* as a subgenus of *Musculus,* list three species from the Eocene of the Paris Basin. Of the three, only one as presently understood could be assigned to *Gregariella,* the Lutetian species *Gregariella arcaeformis* Cossmann, 1887.

Etymology.—Notes the locality, Ridge Creek, where the specimens were found.

Type information.—Holotype: PRI 33072, a left valve, length 5.2 mm, height 2.8 mm, thickness 1.8 mm; paratype: PRI 33073, a right valve. Type locality: locality 4.

Material examined.—Three specimens.

Superfamily **PINNOIDEA** Leach, 1819, p. 329

Family **PINNIDAE** Leach, 1819, p. 329

Genus **ATRINA** Gray, 1842, p. 83

Type species.—*Pinna nigra* Dillwyn, 1817, by subsequent designation (Gray, 1847a, p. 199). Recent in the Red Sea and Arabian Gulf.

Diagnosis.—Cuneiform or ham-shaped anisomyarian clams with large posterior adductor and a small or no anterior adductor. Shell large, broad, fragile, gaping posteriorly. Ligament in narrow groove extending the

whole length of the hinge margin. Shell structure is internally nacreous to about two-thirds or three-quarters of the length, not divided by an internal sulcus, and externally with a prismatic layer of large calcite crystals at right angles to the surface.

Remarks.—The closely similar genus *Pinna* is distinguished from *Atrina* by its straight wedge shape and the division of the nacreous shell layer by a longitudinal sulcus. The clams live upright in sand or mud with the apical end attached by the byssus to a substrate. The genus is known from the Middle Jurassic to Recent.

Atrina? sp.
Plate 3, figures 15, 16

Remarks.—Five small fragments and one fairly complete valve were obtained. The smaller fragments are all from areas near the beak and show that near that point the shell must have been diamond-shaped in cross-section. Outline pinnate with one straight hinge margin and one sinuous margin. The large specimen shows a well-defined nacreous layer extending from the beak as a rounded lobe occupying about three-fifths the length of the shell. Anterior ventral slope and accessory carinal area with straight radial ribs, anterior dorsal slope with obsolete radial sculpture, from the dorsal carina originate numerous curved diverging ribs; these meet the ventral ribs in a narrow area near the ventral carina and generate a complex cross-hatch pattern. Distant from the beaks, sculpture of long irregularly sinuous rounded ribs. The diamond-shaped cross-section can separate this species from *Atrina gravida* (Harris, 1919) and *Atrina cawcawensis* (Harris, 1919), both from the Cook Mountain Formation.

Reference locality: Locality 20.

Material examined.—One fairly complete specimen, 55 mm in length; numerous fragments.

Figured specimens: Beak fragment: PRI 30548; specimen on matrix: PRI 30549.

Superfamily **PTERIDOIDEA** Gray, 1847a, p. 199

Family **PTERIIDAE** Gray, 1847a, p. 199

Genus **PTERIA** Scopoli, 1777, p. 397

Type species.—*Mytilus hirando* Linnaeus, 1758, by monotypy. Recent off the coast of England and southward through the Mediterranean.

Diagnosis.—Shell nacreous, inequivalve, auriculate, the left valve more inflated. Anterior auricle comparatively small, the posterior one ailiform. Exterior surface almost smooth; umbones low and sharp, hinge line straight. A single cardinal tooth under the umbones of each valve; one lateral tooth sometimes present.

Remarks.—The genus is known from the Triassic onwards. Recent members of the genus are found mainly in tropical and subtropical seas. *Pteria* fragments are common in the Claiborne outcrops in Texas but entire valves are rarely found due to their fragility. The type of the genus is characterized by a long extended posterior auricle, weak to inconspicuous dentition and a smooth surface. Harris and Palmer (1946, pp. 36–37) briefly characterized three sections for living *Pteria* but did not formally designate them. Only *Pteria* s.s. has been reported from the Tertiary of the Gulf Coast.

Pteria petropolitana, Stenzel and Twining, 1957
Plate 4, figures 1, 2

Pteria (Pteria) petropolitana Stenzel and Twining, *in* Stenzel, Krause and Twining, 1957, p. 81, 7, figs. 14–6, text fig. 12; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman) 1977, pp. 12, 20.

Original description.—"Right valve thin, nacreous, small (to 16 mm long). oblique (axis of disk making an angle of about 43 degrees with the dorsal margin; . . . moderately inflated. Umbones very small, anterior (at about 0.21 of height). Byssal notch small, shallow, and obtuse. Ventral margin broadly and smoothly arcuate, posterior margin sigmoid, descending below the posterior auricle at an angle of 76°. Dorsal margin long and straight. Anterior ear broken, probably angular, posterior ear long, produced into a narrow, pointed wing extending well beyond the posterior end of the disk. Ligament area long, exceedingly narrow. Tooth-like swellings small, inconspicuous. Sculpture of obscure concentric growth wrinkles only." (Stenzel and Twining, *in* Stenzel *et al.,* 1957, p. 81).

Remarks.—None of the Reklaw specimens recovered has the posterior auricle present but this is probably due to poor preservation. The present species has the angle between the axis of the disc and the dorsal margin extremity equal to that of *P. petropolitana* and also has the very long ligamental area of that species. The latter feature differentiates *P. petropolitana* from other Tertiary species of the Gulf and Atlantic coastal plain.

Figured specimens.—Left valve (in matrix), PRI 30282; right valve, PRI 30283; from locality 7.

Material examined.—14 specimens, the largest: 26.2 mm in length, 16.7 mm height.

Pteria sp.

Remarks.—One specimen appears different from *P. petropolitana* in possessing a semi-quadrate disc shape and a smaller anterior auricle. No posterior auricle is present, and although it may be a worn specimen an examination of the growth lines near the dorsal margin shows no indication of the change in angle that would

imply one was originally present. The specimen is on the surface of a block of matrix and without an examination of the interior it will not be named here.

Order **PTEROIDIA** Newell, 1965, p. 17

Suborder **PTERIINA** Newell, 1965, p. 17

Superfamily **PECTINOIDEA** Rafinesque, 1815, p. 148

Family **PROPEAMUSSIIDAE** Waller, 1972, p. 249

Genus **AMUSIUM** (Bolton) Roeding, 1798, p. 165

Type species.—Ostrea pleuronectes Linnaeus, 1758, by subsequent designation (Hermannsen, 1846, p. 47). Recent in the Indo-Pacific.

Diagnosis.—Shell usually large, thin, suborbicular, slightly inflated, right valve slightly more so than the left; radial sculpture absent on the exterior; auricles subequal; byssal notch small, chondrophore moderately large, shallow and flanked by two cardinal crurae. Interior with narrow ribs not extending to the ventral margin.

Remarks.—Recent members are carnivores, living on small crustaceans in mud-bottom environments (Knudson, 1967, p. 327–329). The genus is known from the Cretaceous to Recent.

Subgenus **PROPEAMUSIUM** de Gregorio, 1884, p. 119

Type species.—Pectin (Propeamusium) ceciliae de Gregorio, 1884, by original designation. Miocene of Italy.

Diagnosis.—Valves rather flattened, thin, polished; usually gaping along lateral margins; valves concentrically sculptured, left sometimes radially striated; byssal notch slight to moderate; about nine internal ribs which do not extend to the margin.

Remarks.—Only two species referable to *Propeamusium* have been recovered from the Gulf Coast, and one of them,—*Amusium (Propeamusium) squamulum* (Lamarck, 1806), is a species originally described from the Paris Basin. Most living members of the group are widely distributed, small, and live in deep water.

Amusium (Propeamusium) zinguli, new species
Plate 4, figures 10, 11

Description.—Shell very small, ovate to 3.6 mm in length, 3 mm width, slightly convex. Sculpture of about 56 riblets crossed by fine concentric imbricated threads, more widely spaced towards the valve margins. A few riblets tend to develop in the interstices between the main ones. Interior with nine ribs extending almost towards the valve margins. Pallial sinus large and rounded, extending almost to a line connecting the auricular margins.

Remarks.—A similar form and also of similar size is *Amusium (Propeamusium) alabamensis* (Aldrich, 1886) from the Midway Group of Alabama. That species has a few weak radial lines in the center of the disc and on the anterior side of the shell. Tertiary members of this group, even when adult, are typically less than 15 mm in size.

Etymology.—This species is named in honor of paleontologist Dr. Richard Zingula, formerly of Exxon Corporation, Houston.

Type information.—Holotype: a left valve, PRI 30284; paratype: PRI 30285. Type locality: locality 4.

Material examined.—Seven specimens, the largest: 4.5 mm length, 4.3 mm height, 0.7 mm width. Mean ratios: height/length .96, width/height .16, umbones central.

Family **PLICATULIDAE** Watson, 1930, p. 29

Genus **PLICATULA** Lamarck, 1801, p. 132

Type species.—Spondylus plicatus Linnaeus, 1758, by subsequent designation (Schmidt, 1818, p. 61). Recent in the Indo-Pacific.

Diagnosis.—Shell inequivalve, flattened or slightly convex, trigonal to subcircular, commonly irregular, attached by umbone of right valve. Exterior surface generally plicate or foliate. Ligament internal, located in a central cartilage pit between two large transversely striate crurae; valve margins fluted.

Remarks.—Only a few species of *Plicatula* have been described from the Tertiary of the coastal plain. At several places in the Wheelock and Landrum Members of the Cook Mountain Formation in Texas, *Plicatula filamentosa* Conrad 1833a forms a shell bed to the exclusion of almost all other species. Good exposures may be seen in the lowest beds of the Wheelock Member on the banks of the Little Brazos River near Bryan, and exposures in the Landrum Member in the banks of Hurricane Bayou near Crockett. Modern representatives are suspension feeders and usually attached to rocks or other hard substrate, primarily in warm tropical seas. The genus ranges from the Middle Triassic to Recent.

Plicatula pustula, new species
Plate 4, figs. 3, 4

Description.—Shell small to medium sized, the largest specimen 26 mm. Shell form very irregular, in juvenile specimens strongly tumid and with predominantly concentric growth lines; beyond a particular growth stage of ca. 10 mm in size the shell flattens out and the outer surface develops about eight to ten very rough irregular radial lamellose costae. Resilium pit small, crurae diverging in young specimens, massive, projecting, and tending to become parallel in large ones. Adductor scar prominent, moderate in size,

orbicular, and slightly posterior. In the largest specimens the scar is elevated to a prominent projecting boss. Interior valve margins obscurely crenulated.

Remarks.—The irregular character of the shell surface is more reminiscent of the Ostreinae but the hinge characters place it in the Plicatulidae. *Plicatula? louisiana* Harris, 1946, *Plicatula creola* Allen, 1970 both from the Moodys Branch Formation, and an undescribed form from the Cook Mountain Formation in Texas, are other species of this group having a similar early inflation, that later flattens out. Most specimens are fragmentary or worn, but a few specimens do show a minutely spinose surface, a feature also seen on *P. creola*; the prominent adductor scar and heavy hinge teeth can serve to distinguish *P. pustula* from that species. The common *P. filamentosa* is a more regular and less inflated species. Two specimens are attached over a large portion of the exterior, a character typical of the Ostreidae, while *Plicatula* is usually attached by the umbones.

Etymology.—The specific name *pustula* (Latin, pimple), refers to the prominent adductor scar in the shell's interior.

Type information.—Holotype: a right valve, PRI 30286; paratypes: PRI 30287, 30288. Type locality: locality 20.

Material examined.—38 specimens, numerous fragments. Dimensions of the largest: 24.0 mm length, 26.0 mm height, 8.0 mm width (including dentition).

Suborder **OSTREINA** Férussac, 1822, p. xxxix

Superfamily **OSTREOIDEA** Rafinesque, 1815, p. 21

Family **GRYPHAEIDAE** Vyalov, 1936, p. 19

Subfamily **PYCNODONTEINAE** Stenzel, 1959, p. 16

Genus **HYOTISSA** Stenzel, 1971, p. N1107

Type species.—*Mytilus hyotis,* Linnaeus, 1758, by original designation. Recent in the Indo-Pacific.

Remarks.—The genus ranges from the Late Cretaceous to Recent and is restricted to deeper waters of the open sea where salinity and temperature stay within a narrow range.

Hyotissa offemanae, new species
Plate 4, figures 5–9

Description.—Shell to about 6 cm long and high, shape circular to moderately higher than long, rarely falcate. Left valve moderately capacious, attachment area 50% of valve area or more. Shell commissure strongly plicate, plicae rounded to sharp-topped, not divaricate; occasional scale-like extensions on ribs. Interior with oval attachment scar, higher than long. Resilifer large, tip curved to the left, set at angle of about 60° to valve margins. Chroma long, often occupying more than 50% of the valve margins. Right valve concentrically imbricate, sometimes with low radial plications, commissure not plicate. Exterior of both valves prominently vesiculate where worn.

Remarks.—Stenzel (1953, p. 75–76) noted a marine faunule in the Newby Member of the Reklaw Formation containing a deep water pycnodont oyster. The locality was visited in 1988 and found to be very weathered, but *H. offemanae* could still be collected where it outcrops on several indurated ironstone/clay ledges. In the Marquez Member at Joe Taylor Branch and Ridge Creek, juvenile specimens of a pycnodont occur, recognizable by the vesicular shell structure, but they are too small to assign confidently to *H. offemanae.* The subfamily occurs very rarely in the Claiborne and is only represented by one described species *Pycnodonte (Pycnodonte) trigonalis* (Conrad *in* Wailes, 1854). Palmer and Brann (1966) assigned it to *Gigantostrea* but the vesicular shell structure indicates the assignment is in error. In the Claiborne Group, the author only knows of two other *Pycnodonte* specimens of a new species from the Wheelock Member. The closest described species is *Ostrea tacalensis* Hodson, 1927, from the Eocene/Oligocene of Venezuela, which is a more elongate species with a smaller attachment area than *P. offemanae.* A somewhat similarly sculptured species is *Ostrea crenulimarginata* Gabb, 1860, from the Clayton Formation of Alabama and the Kincaid Formation of Texas; this species is more elongate and lacks the radial plications on the upper valve. The absence of the vesicular shell structure in *O. crenulimarginata* also precludes placement in the pycnodont group of oysters.

Etymology.—Honoring Irene Offeman, one of the founding members of the Paleontology Section of the Houston Gem and Mineral Society whose enthusiasm and dedication to paleontology has inspired the Society's members.

Type information.—Holotype: a left valve, PRI 30554; paratypes: PRI 30555, 30556. Type locality: locality 25.

Material examined.—30 more or less fragmentary specimen, the largest 65 mm length.

Subclass **HETERODONTA** Neumayr, 1883, p. 5

Order **VENEROIDA** H. and A. Adams, 1858, p. 347

Superfamily **LUCINOIDEA** Anton, 1839, p. 6

Family **LUCINIDAE** Fleming, 1828, p. 409

Subfamily **MILTHINAE** Chavan, 1969, p. I501

Genus **ANODONTIA** Link, 1807, p. 156

Type species.—*Anodontia alba* Link, 1807, by monotypy. Recent in the West Indies.

Diagnosis.—"Shell of large to very large size, thin, longer than high, strongly inflated, anterior expansion small or moderate. Surface sculpture concentric, fine to distinct, with irregularly spaced growth rings; dorsal areas faint to distinct. Lunule long, shallow, variable in shape. Ligament external or slightly inset. Anterior adductor scar variable in shape and position; posterior adductor scar elliptical. Anterior pedal retractor scar separate from adductor, posterior one not evident. Pallial blood vessel line scar present; inner ventral margin smooth." (Bretsky, 1976, p. 302).

Remarks.—A suspension feeder, which is often able to tolerate extremely poor conditions although the preferred habitat is near shore, in sandy, grassy environments. The genus is known from the Paleocene to Recent.

Subgenus **EOPHYSEMA** Stewart, 1930, p. 186

Type species.—Lucina subvexa Conrad, 1833b, by original designation. Eocene, Gosport Sand Formation? (*cf.* Bretsky, 1976, pp. 305–306) of Alabama.

Diagnosis.—"Shell, thin, size very small to medium, larger than high, moderately inflated. Surface sculpture predominantly concentric, with fine radials. Dorsal area faint to distinct. Lunule long wide, triangular, shallow. Ligament external. Anterior adductor scar small, bent away from the pallial line, posterior adductor round. Anterior pedal retractor scar not evident. Hinge plate narrow, edentulous or with obsolete anterior and posterior laterals, and with one cardinal in the right valve, two in the left valve. Inner margin smooth." (Bretsky, 1976, p. 305).

Remarks.—The subgenus ranges from the Paleocene to Recent. Living representatives live in tropical and subtropical waters.

Anodontia (Eophysema) reklawensis, new species
Plate 5, figures 1–4

Description.—Shell small, height 92% of width and moderately inflated, thickness about 24% of length. Sculpture of fine and almost regular concentric lamellae which form short pointed nodes at the dorsal ends of the shell. The interstices of the lamellae show fine irregular radial striae of various lengths which continue over the lamellae. Lunule triangular, long and depressed. Anterior adductor scar lengthened and in the middle bent away from the pallial line, posterior adductor scar elliptical, anterior pedal scar round and separate, posterior one not noticeable. Left valve with one thin cardinal, pointing upward near the dorsal end and situated next to a triangular socket; right valve with bifid cardinal. The only prominent lateral tooth is the anterior one in the right valve.

Remarks.—Two species and varieties referable to *Eophysema* have been described from the Paleogene of the Southern Embayment, *Anodontia (Eophysema) subvexa* (Conrad, 1833b) and *Anodontia (Eophysema) ozarkana* (Harris, 1897b). Apart from its far larger size, *A. (E.) subvexa* is a relatively solid shell with a sculpture of low rounded undulations and a pitted interior. A closer species is *A. (E.) ozarkana,* but that has a more rounded profile, has more concave ventral hinge margins, and has a somewhat irregular sculpture of low undulations, rarely foliated.

Type information.—Holotype: left valve, PRI 30289; paratype: right valve, PRI 30290. Type locality: locality 20.

Material examined.—13 specimens, the largest: 7.0 mm length, 6.6 mm height, 1.8 mm width. Mean ratios: height/length .92, width/height .26, umbones central.

Anodontia (?) sp.

Remarks.—One specimen referable to *Anodontia* but different from the previously described species was found. This specimen is larger, somewhat anteriorly produced, has a longer ligamental groove, and a straight anterior adductor scar. Externally this species is smoother and shows none of the incremental radials that are a characteristic feature of *Eophysema.* It is possible this is a juvenile specimen of *Anodontia? augustana* Gardner, 1951, a species from the Tallahatta Fomation of Alabama and the Congeree Formation of South Carolina. The two species share a similar outline, an edentulous hinge, and the radiating lines on the interior which Gardner (1951, p. 10) mentioned occurring on interior molds of *A.? augustana.*

Superfamily **CHAMOIDEA** Lamarck, 1809, p. 89

Family **CHAMIDAE** Lamarck, 1809, p. 89

Genus **CHAMA** Linnaeus, 1758, p. 691

Type species.—Chama lazarus Linnaeus, 1758, by subsequent designation (ICZN opinion 484, 1957). Recent in the Indo-Pacific.

Diagnosis.—Typically sessile, attached by the left valve; beaks dextrally coiled; ornamentation spinose; comarginally foliated or lamellose. Lunule absent, ligament narrow and set in a deep groove. Adductor scars large, rough, and subequal. Interior of some species often pitted.

Remarks.—The animals are epifaunal, adapted for life on hard substrates; most species have a low tolerance to salinity changes. The genus ranges from the Paleocene (doubtfully the Upper Cretaceous) to Recent.

Chama taylorensis, new species
Plate 5, figures 5–6

Description.—Shell small, suborbicular. Right valve with irregular concentric rows of foliations which become progressively coarser, more pronounced and spinose towards the posterior ventral area. The spines are convex above, grooved below and tend to curve upward from the shell surface. The left valve with larger foliations and fewer spines. Right valve dentition obsolete anteriorly, posteriorly with a pronounced ligamental pit, 3b and PI large. The left valve with two very large teeth, the others obsolete. Beaks strongly incurved and spirogyrate. Except for the area under the beak, the interior of both valves is strongly pitted, that of the left valve is also linearly striate near the pallial line.

Remarks.—*Chama taylorensis* differs from the Cook Mountain Formation species, *Chama harrisi* Gardner, 1927, in possessing foliations that are irregularly spinose at the edges, particularly so at the ventral margin. The external sculpture of *C. harrisi* is predominantly radial, with the spines arranged on radial, sometimes bifurcating ribs. *Chama monroensis* Aldrich, 1903b, another species from the Cook Mountain Formation, possesses prominent foliations that are upturned at the edges. These foliations are not spinose, and have impressed radial lines that are arranged in pairs. An undescribed species, similar in many respects to *C. monroensis* is reasonably common in the Cook Mountain Formation of Texas, and may be distinguished by its totally smooth foliations. A closer species than either *C. harrisi* or *C. monroensis* is *Chama (Psilopus) mississippiensis* Conrad, 1848, from the Vicksburg Group. This species has radially arranged spines on the edges of the foliations. The Reklaw species can be distinguished from all of the preceding species, by the strongly pitted interior of the valves, the fairly regular, comarginal foliations, and the irregularly placed spines. Eocene species of *Chama* are usually small, most figured species being within a range of 8–20 mm.

Type information.—Holotype: left valve, PRI 30294; paratype: right valve, PRI 30295. Type locality: locality 20.

Material examined.—33 specimens, the largest: 12.2 mm length, 10.0 mm height, umbones at about 26% of length.

Superfamily **CARDITOIDEA** Fleming, 1820, p. 668

Family **CARDITIDAE** Fleming, 1820, p. 668

Subfamily **VENERICARDIINAE** Chavan, 1969, p. N554

Genus **VENERICOR** Stewart, 1930, p. 155

Type species.—*Venericardia planicosta* Lamarck, 1799, by original designation. Eocene of the Paris Basin and the Bracklesham beds of England.

Diagnosis.—Shell large, heavy; outline trigonocordate. Umbones inflated, anterior extremity short and obliquely rounded, posterior lateral margin slightly truncate. Lunule narrow and long delimited by a groove; escutcheon not defined. Earliest ribbing narrow, sharp, and crenate; adolescent and early adult ribs anteromedially flat-topped, the ribs wider than the interfaces; near the margins the collabral growth lines are prominent and often become dominant in large specimens. Hinge plate high and trigonal; anterior cardinal thin and lamellar, medial one heavy, posterior one lamellar and parallel with the inner margin of the nymph. Pallial line ragged and set back from the crenate valve margins.

Remarks.—The genus ranges from the Paleocene to the Oligocene.

Venericor densata reklawensis, new subspecies
Plate 6, figures 1–4

Venericardia (Venericor) densata Gardner and Bowles, 1939, p. 154.

Description.—The Reklaw specimens are ovate-triangular in outline, lunule sharply notched at the margin in larger specimens. Hinge plate smaller, margin straight to weakly sinuous, anterior cardinal is broad, flattened and almost vertical. The umbonal rib sculpture is T-shaped, rounded serrate in form, barely overhanging and dying out earlier than *densata* s.s.

Remarks.—The combination of smaller hinge area, ovate-triangular outline and notched lunule shell margin will distinguish this subspecies from typical *V. densata.* In a comparison between specimens from the Weches Formation, Stone City, Landrum, and Wheelock members of the Cook Mountain Formation in Texas, the following further differences were noted: Weches specimens have similar hinge characteristics but a regularly rounded outline; Stone City specimens possess a thicker obliquely inclined anterior tooth, costal nodes over the entire umbo, sometimes a similar outline, but a much larger hinge area; Landrum and Wheelock specimens have a larger hinge and have a vertically compressed outline. Stenzel (1953, p. 78) reports an abundance of *Venericardia planicosta* Lamarck in the Newby Member in the Tyler Basin of east Texas that is referable to this subspecies.

Type information.—Holotype: left valve, PRI 30296; paratype: right valve, PRI 30297. Type locality: locality 20.

Material examined.—48 specimens, the largest 5.95 cm length, 5.68 cm height, 1.91 cm thickness. Mean ratios: height/length .95, width/height .39, umbones/length .31.

Subfamily **CARDITESINAE** Chavan, 1969, p. N556

Genus **CLAIBORNICARDIA** Stenzel and Krause, 1957, pp. 104–105

Type species.—Cardita alticostata Conrad, 1833c, by original designation. Eocene, Gosport Sand Formation of Alabama.

Diagnosis.—Venerids with highly inflated shell, high degree of posterior and posterio-ventral elongation and generally inflated beaks. Ornamentation of radiating noded or terraced costae, tripartite in cross-section. Right valve dentition with a right blade-like anterior lateral (3a), which is a continuation of the dorso-anterior point of the medial cardinal (3b), and dorsal to the socket for the left-valve anterior cardinal tooth; socket narrowly or broadly triangular in shape. Dorso-ventral cross-section a fairly regular spiral which tends to flatten out as it approaches the ventral margin.

Remarks.—The genus ranges from the Lower Eocene to the Oligocene.

Claibornicardia linguinodifera milamensis, new subspecies
Plate 5, figures 11, 12

Description.—Shell small in size, quadrate in outline with strongly inrolled beaks. Right valve dentition: cardinal tooth 3a small, and blade-like, situated just left of 3b; cardinal tooth 3b blunt at the apex, sinuous; cardinal tooth 5b absent. Left valve dentition: cardinal 2a horizontal blade, flat ventrally, rounded-triangular dorsally; cardinal tooth 4b long and moderately sinuous. Ornamentation of 23–25 ribs that are tripartite in shape except on the posterior slope. Costal nodes flattened and tongue-like, paracostals terraced with rounded corners and where these are large enough similarly rounded in concert with the central nodes. Growth lines very marked and regularly wrinkled within the intercostals.

Remarks.—This subspecies is very likely intermediate in evolutionary position between *C. linguinodifera* and *C. coloradonis coloradonis* Heaslip, 1968 from the Weches and Bashi Formations respectively. It has very similar ornamentation to *C. linguinodifera* while possessing the outline of *C. c. coloradonis.* This new subspecies is less inflated, has the umbones more centrally placed, and is more elongate along the dorso-ventral axis than either of the latter two species.

Type information.—Holotype: right valve, PRI 30298; paratype: left valve, PRI 30299. Type locality: locality 20.

Material examined.—17 specimens, the largest: 14.5 mm length, 15.0 mm height, 4.9 mm width. Mean ratios: height/length 1.05, width/height .32, umbones/length .36.

Claibornicardia coloradonis subsp.
Plate 5, figures 7–10

Venericardia (rotunda?) var. *coloradonis* Harris, 1919, p. 81, pl. 29, fig. 9; Harris, 1946, p. 68; Palmer and Brann, 1965, p. 341.
Venericardia (rotunda) varying toward *trapaquara* Harris, 1919, pp. 80–81, pl. 29, figs. 6, 7.
Venericardia rotunda Lea, Plummer, 1933, pp. 641, 811–812, pl. 8, figs. 7a, 7b.
Venericardia trapaquara Harris (in part), Harris, 1919, pp. 81–82, pl. 30, figs. 6–7, 9.
Venericardia trapaquara subsp. *texalana* Gardner, 1927, pp. 370–371, figs. 24–27; Renick and Stenzel, 1931, p. 108; Stenzel et al., 1957, p. 106; Harris, 1946, p. 68 (variety *texalana* Gardner).

Description.—"Similar in general characteristics of shape and dentition to *V. (C.) linguinodifera,* but differs in higher degree of postero-ventral elongation and more highly developed posterior truncation, smaller lower umbones, and less closely or regularly arranged tongue-like costal nodes" (Heaslip, 1968, p. 100).

Remarks.—In the Texas Memorial Museum collections are venericards very close to *Claibornicardia coloradonis texalana* Gardner, 1927 from the Lower Weches Formation, differing in having a higher degree of postero-ventral elongation, about 20 ribs as opposed to about 25, and a dental pattern that is more similar to the *Claibornicardia linguinodifera* Heaslip, 1968, group from the early Eocene Bashi Formation. The exterior ornamentation is the same as *C. coloradonis texalana.* The specimens are from the Devil's Eye locality, where the exact stratigraphic level is not known.

Type information.—Figured specimens: left valve: TMM 8482, right valve: TMM 8483. Type locality: locality 11

Material examined.—Seven specimens, the largest 21.0 mm length, 18.5 mm height, 6.0 mm width. Mean ratios: height/length 1.02, width/height .39, umbones/length .25.

Superfamily **MACTROIDEA** Lamarck, 1809, p. 318

Family **MACTRIDAE** Lamarck, 1809, p. 318

Subfamily **MACTRINAE** Lamarck, 1809, p. 318

Genus **TENUIMACTRA**, new genus

Type species.—Tenuimactra hodgkinsoni, new species.

Diagnosis.—Shell small, ovate-trigonal, moderately to highly inflated. Sculpture concentric only. Right valve hinge with small resilial socket, anterior edge bounded by a prominent raised tooth, posteriorly with relatively large inverted V-shaped cardinal, set almost parallel to the hinge margin. Anterior laterals absent, posterior laterals very small to obsolete. A deep furrow

runs from the umbo to the posterior end of the hinge area. Eschutcheon weakly defined by an impressed line.

Remarks.—Externally these specimens look similar to venerids but the hinge is relatively simple with a resilial socket, and an inverted V-shaped cardinal. The anterior-dorsal hinge margin of *Tenuimactra* is smooth and rounded, very different from the hinge furrow and anterior lateral teeth of most representatives of that family and the resilial socket is very small in comparison with the V-shaped cardinal of most Mactridae. The lack of lateral teeth is similar to *Lutraria* s.s. although in that genus the valve shape is prominently elongate and lacks an eschutcheon. Stenzel, Krause, and Twining 1957, report only one mactrid, *Kymatox* Stenzel and Krause, 1957, (=*Pteropsis* Conrad, 1860) from the Stone City Member. *Kymatox* has a sculpture of broad concentric undulations, a left valve with a prominent posterior lateral tooth and a thin, large, upturned hinge plate; the right valve with two cardinal teeth, and two strong posterior lateral teeth.

Etymology.—*Tenui* (Latin, simple) *mactra*-like, notes the very simple hinge characteristics.

Tenuimactra hodgkinsoni, new species
Plate 6, figures 5–8

Description.—As in the generic diagnosis.

Remarks.—All specimens were found attached to blocks of sandy-glauconitic matrix, are extremely delicate and had to be coated with hardener. The two specimens whose hinge was examined were first embedded in wax for stability before preparation took place and this has darkened the shell in places. The interior of both prepared specimens shows a blue colored band set back and parallel with the hinge margin. In the best-preserved specimen this band also changes direction at the anterior end as though defining a pallial sinus. The color is not believed to have any connection with the pallial sinus. Although only discerned with greatest difficulty, the pallial line appears as a reflective band parallel to most of the ventral margin; muscle scars not seen but may be obscured by the discoloration by the wax. The best specimen (now cemented to the wax base) shows a very close external resemblance to *Dermatomya? harrisi* Weisbord, 1929, from the Miocene of Colombia. The interior of *Dermatomya*, however, is nacreous or subnacreous.

Etymology.—The specific name honors Dr. Kenneth Hodgkinson, paleontologist and researcher on the Gulf Coast Tertiary Mollusca.

Type information.—Holotype: a right valve, PRI 33074, 6.7 mm length, 5.9 mm height; paratypes: PRI 30443-30446. Type locality: locality 4.

Material examined.—Four specimens, the largest (somewhat crushed), 16.3 mm length, 12.5 mm height.

Superfamily **SOLENOIDEA** Lamarck, 1809, p. 319

Family **SOLENIDAE** Lamarck, 1809, p. 319

Genus **EOSOLEN** Stewart, 1930, p. 290

Type species.—*Solen obliquus* Deshayes, 1860, by original designation. Eocene of the Paris Basin, France.

Diagnosis.—Shell elongate flattened, hinge with one tooth in each valve. Anterior end with an external oblique groove. Beaks at extreme anterior end.

Remarks.—According to Stewart (1930), this genus is restricted to the Eocene. Modern representatives of the family live upright in sand or mud in nearshore environments.

Eosolen shirleyi, new species
Plate 5, figure 13

Description.—Shell moderate in size, straight posteriorly and medially, slightly curved on the anterior quarter. Posterior end very slightly oblique and smoothly rounded, anterior end characterized by a deep oblique sulcus. Surface smooth except for lines of growth which become very much stronger over the anterior end forming irregular rounded lines. Posterior-dorsal margin with a sharp raised edge, margined below by a narrow depression which becomes obsolescent medially.

Remarks.—This species is differentiated from *Eosolen lisbonensis* (Aldrich, 1886) from the Lisbon Formation, by the less angulated anterior end and shorter form, from *Solen pendeltonensis* Barry, 1942 from the Wilcox group, by the strong groove, wider form and strong growth lines, and from *Solena (Eosolen) lisbonensis abruptus* (Dall, 1900) from the Cook Mountain Formation by its more elongate form and rounded anterior end. Palmer and Brann (1965) questionably assign Dall's species to *Eosolen.* The posterior-dorsal angulation can also distinguish *E. shirleyi* from the preceding three species. The Reklaw specimen is attached to a block of matrix so the interior cannot be observed.

Etymology.—Named after my wife Shirley, who discovered the first specimen.

Type information.—Holotype: a right valve, PRI 30301. Type locality: locality 14.

Material examined.—Six specimens, length: 26.2, height: 7.5 mm.

Superfamily **TELLINOIDEA** Blainville, 1814, p. 179

Family **TELLINIDAE** Blainville, 1814, p. 179

Subfamily **TELLININAE** Blainville, 1814, p. 179

Genus **TELLINA** Linnaeus, 1758, p. 674

Type species.—*Tellina radiata* Linnaeus, 1758, by subsequent designation (Schmidt, 1818, p. 51). Recent in the West Indies.

Diagnosis.—Shell ovate to ovate-trigonal, compressed, usually rostrate. Umbones subcentral or posterior to mid-length. External surface rarely smooth, dominant sculpture usually concentric, commonly suggested by the color pattern and sometimes internal rays. Ligament external, situated in an elongate groove. Two small cardinals in each valve, at least one of them bifid. Lateral teeth always present in one valve, usually strongly developed in the right valve, weaker and sometimes obsolescent in the left. Pallial sinus large, coalescent ventrally with the pallial line, anterior adductor muscle scar of similar size but more elongated than posterior.

Remarks.—The genus ranges from the Upper Cretaceous to Recent. Recent species of the genus are cosmopolitan in distribution, occurring in both polar and tropical waters, and from the high tide level to depths greater than 600 fathoms.

Subgenus **EURYTELLINA Fisher, 1887**, p. 1147

Type species.—Tellina punicea Born, 1778, by monotypy. Recent from East Coast of Central America.

Diagnosis.—Shell elongate-ovate, posterior end not rostrate; umbones very slightly anterior, sculpture of fine concentric lines or threads; two lateral teeth in both valves, left valve laterals not as prominent; right posterior and left anterior cardinal teeth trigonal and bifid; pallial sinus the same in both valves, touching the anterior adductor scar.

Remarks.—The subgenus ranges from the Eocene to Recent, and is restricted to North and South America.

Tellina (Eurytellina?) milamensis, new species
Plate 6, figures 9, 10

Description.—Shell equilateral, height 57% of length, umbones almost central at 53% of length. Beak not incurved, not prominent, lunule not visible, escutcheon small and defined by a sharp concave ridge. Left valve with bifid anterior cardinal tooth parallel to the dorsal-ventral mid-line, and another smaller, thin lamellar posterior cardinal tooth, the dorsal end merging into the anterior margin of the small nymph. Posteriorly to the nymph is a rounded callosity extending externally from the valve margin. Anterior dorsal margin almost straight and parallel to the posterior ventral margin, posteriorly acuminate. Rostral area defined by a weak rounded angulation and a few obscure radial rays. Surface smooth or with concentric undulations which are well-defined behind the rostral angulation and on the extreme anterior dorsal margin. Traces of color banding still preserved, consisting of thin brown streaks originating at the rostral area and increasing in size and prominence towards the anterior dorsal margin.

Remarks.—Without examination of the shell interior this species might be assignable to either *Eurytellina,* Fisher, 1887, or *Moerella,* Fisher, 1887. Both subgenera are reported by Stenzel *et al.* (1937) and Palmer and Brann (1966) from the Texas Claibornian. Keen (1969, p. N615) gives the geologic range of *Eurytellina* as Miocene–Recent, and *Moerella* as Early Eocene–Recent. All available specimens are cemented to blocks of matrix. The hinge description is made possible by the breaking of one specimen free of the matrix, but that was still not enough to determine the subgenus. The shell outline, the medium sized bifid tooth and the obsolete radial sculpture make an assignment to *Eurytellina* more likely. *T. (E.) milamensis* can be distinguished from its closest relative, *Tellina (Eurytellina) mooreana* Gabb, 1860 from the Weches Formation, and Stone City Member of the Cook Mountain Formation by its more trapezoidal shape, the excavated area posterior to the beak, and the obsolete sculpture. The left valve of *Tellina (Eurytellina) papyria* Conrad, 1833b from the Lisbon and McBean formations, another similar species, has not been described but its hinge shows a large bifid anterior cardinal and no posterior cardinal, its place taken by the raised margin of the nymph. All specimens of *T. (E.) milamensis* are very thin, many are even translucent.

Type information.—Holotype: a left valve, PRI 30302; paratype: right valve hinge fragment, PRI 33121. Type locality: locality 20.

Material examined.—Ten specimens the largest: 15.0 mm length, 8.5 mm height, umbones at 53% of length.

Genus **ARCOPAGIA** Brown, 1827, pl. 16, fig. 8

Type species.—Tellina crassa Pennant, 1777, by subsequent designation (Hermannsen, 1846, p. 76). Recent, on the boreal coast of Europe.

Diagnosis.—Shell large or small, orbicular, solid, rounded, moderately convex. Posterior flexure obsolete, beak high. Sculpture concentric, rarely radial, usually smooth or sometimes reduced to incremental lines. Two cardinals in each valve, the right posterior and left anterior bifid, right valve with strong laterals, left valve usually with obsolete laterals. Pallial sinus not close to the anterior adductor scar. The chief feature of this group is the free and ascending sinus.

Remarks.—Afshar (1969) is followed in giving *Arcopagia* generic rank. This genus is known from the Cretaceous to Recent, today primarily in the Indo-Pacific. The type subgenus has a similar pallial sinus in both values and the ventral margin of the pallial sinus entirely free.

Arcopagia (Arcopagia) trumani (Harris)
Plate 6, figures 11–13

Tellina (Arcopagia) trumani Harris, 1897b, p. 73, pl. 12, fig. 15, pl. 14, figs. 10, 10a.

Description.—Shell small, compressed-elliptical; beaks central. Pallial sinus large, margins parallel, extending a distance three-quarters into the shell interior. Left valve cardinal asymmetrically bifid. Right valve with a deep groove dorsal to the anterior lateral tooth.

Remarks.—Eight specimens were obtained that have a very similar outline to *T. (A.) trumani,* a species from the Lower Eocene. The surface is covered with raised concentric fine threads, not noticeably weaker towards the dorsal margin. The outline does not have the weak emargination of *Arcopagia (Arcopagia) trumani australina* (Harris, 1919), a later representative from the Middle Eocene. The two cardinal teeth, only visible in the left valve, are very small and almost fused, the anterior one is bifid. *Tellina tallicheti* Harris, 1895a from the Weches at Smithville, Bastrop County, Texas, is another similar species but its exterior is mostly smooth and has a bifid posterior cardinal. This record extends the occurrence of *T. (A.) trumani* into lowest Claibornian times.

Type information.—Three syntypes: PRI 170, 230, 231. Type locality: Gregg's Landing, Alabama River, Alabama. Range Lower Eocene, Tuscahoma Formation of Alabama, to Middle Eocene, Reklaw Formation of Texas. Figured Reklaw specimens: a right valve, PRI 33076; a left valve fragment, PRI 33122, from locality 20.

Material examined.—Eight specimens. Dimension of the largest: 10.8 mm length, 9.0 mm height, umbones at 55% of length.

Superfamily **ARTICOIDEA** Newton, 1891, p. 295

Family **KELLIELLIDAE** Fisher, 1887, p. 1022

Genus **LUTETIA** Deshayes, 1860, p. 787

Type species.—*Lutetia parisiensis* Deshayes, 1858 (in Atlas of plates), by subsequent designation (Stoliczka, 1871, p. 279). Eocene of the Paris Basin.

Diagnosis.—Shell very small, globose, circular in outline. Umbo almost central, beaks pointed in an anterior direction. Surface smooth or with slight concentric undulations. Interior highly polished, adductor muscle scars small, equal, oval; pallial line simple. Ligament external, on the nymph. Hinge with three teeth in each valve. Right valve with one tooth beneath the lunule and parallel to the margin, a central lower one commonly L-shaped and a posterior one pointing backwards; valve margin grooved. Left valve teeth laminar.

Remarks.—The genus is known from the Eocene to Recent, Europe and North America.

Lutetia cf. **texana** Harris, 1920
Plate 7, figures 7–10

Lutetia texana Harris, 1920, p. 7, pl. 17, figs. 7, 8; Gardner, 1945, p. 99, in part; Brann and Kent, 1960, p. 989.

Description.—Shell very small; ovate to slightly elliptical in outline. Exterior smooth, shining, with weak concentric undulations. Lunule large, well defined by a radiating, impressed line. Ligamental margin deeply channeled. Cardinal area narrow. Right valve with a prominent tooth just posterior to the umbo; left valve with a corresponding deep pit.

Remarks.—The Reklaw specimens differ from *Lutetia texana* s.s. by their smaller size, and in the right valve the central lower tooth is slightly thinner and more elongate. The differences however are not considered significant particularly as all specimens appear to be juveniles. Despite the fact that *Lutetia* has only previously been reported from the Weches Formation at Nacogdoches, Texas, it is in fact well represented throughout the Texas Claibornian.

Type information.—Holotype: a right valve, PRI 33081, 0.5 mm diameter; paratypes: PRI 33082–33084. Type locality: locality 4.

Material examined.—39 specimens, the largest 0.6 mm diameter.

Genus **ALVEINUS** Conrad, 1865b

Type species.—*Alveinus minutus* Conrad, 1865b, p. 138, by monotypy. Eocene, Gosport Sand Formation of Alabama.

Diagnosis.—Shell minute, equivalved, smooth. Right valve with two parallel teeth, resilial pit below the beak, posterior valve margin channeled. Left valve with corresponding resilial pit, a bifid tooth anteriorly and anterior valve margin channeled. Pallial line entire.

Remarks.—Palmer and Brann (1965) only report this genus from the upper Claiborne Gosport Sand Formation of Alabama and the Jackson Group of Louisiana. In the author's experience, however, it occurs abundantly in all Claibornian exposures. The range of the genus is Eocene to Miocene.

Alveinus cf. **minutus** Conrad, 1865b
Plate 7, figures 11–12

Alveinus minutus Conrad, 1865b, p. 138, pl. 10, fig. 2, as *minuta*; 1872, p.53, pl. 1, fig. 6; Meyer, 1885, p. 467; 1886b, p. 84, pl. 1, fig. 19; Dall, 1899, p. 883; 1900, p. 1166; Harris, 1919, p. 110, pl. 37, fig. 15 copy Meyer; 1920, p. 8, pl. 17, figs. 11–15, text-fig. 5; Harris and Palmer, 1946, p. 83, pl. 19, figs. 5, 5a copies Harris, 1920; Brann and Kent, 1960, p. 989; Olsson, 1964, p. 44;

Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 33.
Alveinus parvus Conrad, 1865a, p. 10, as *parva nomen nudum*; 1866a, p. 24 *nomen nudum*; de Gregorio, 1890, p. 210 not *mimatur* as in synonymy, pl. 30, fig. 30, fig. 14 copy Meyer, fig. 14b copy Conrad; Dall, 1903, p. 1166.
Lutetia parva (Conrad). Cossmann, 1893b, p. 13.

Original description.—"Suboval or suborbicular, very inequilateral, convex, smooth and shining; margins rounded. This is a minute shell, much enlarged in the figure, and common in a small quantity of marl which accompanies the specimens. The family to which it should be referred is undetermined. A microscopic channel margins the valves within." (Conrad, 1865b, p. 138).

Remarks.—Only two right valves were obtained of this species. Both have an almost identical outline but are about half the size of typical Gosport Sand specimens. The hinge characters are a little different; the resilial pit is smaller, shifted anteriorly and its place taken up by an elongated and more angular upper tooth. Whether or not this is enough to separate the Reklaw specimens must await the discovery of more material.

Type information.—Three syntypes: ANSP 13221 (Moore, 1962, p. 75). Figured Reklaw specimen: a right valve, PRI 33085, from locality 4.

Material examined.—Two Reklaw specimens, ca. 1.3 mm diameter. Numerous Cook Mountain and Gosport Sand specimens.

Superfamily **VENEROIDEA** Rafinesque, 1815, p. 20

Family **PITARIIDAE** Stewart, 1930, p.232

Subfamily **PITARINAE** Stewart, 1930, p. 232

Genus **PITAR** Römer, 1857, p. 15

Type species.—*Venus tumens* Gmelin, 1791, by monotypy. Recent, west coast of Africa.

Diagnosis.—Shell oval to subtrigonal, moderately to strongly inflated, umbones anterior, beaks prosogyrate. Ornamentation smooth or finely lamellate, comarginal ribs, lunule defined by an incised line, escutcheon long, poorly defined. Right valve with two anterior lateral hinge teeth, and three cardinal teeth; posterior cardinal tooth (3b), elongate, almost horizontal, and bifid. Left valve: 2b triangular, joined to a thin 2a, 3a and 1 separate. Pallial sinus deep, reaching midlength. Valve margins smooth.

Remarks.—The genus ranges from the Paleocene to Recent. At least 33 species are described from the Paleogene of the Gulf and Atlantic Coastal Plains.

Subgenus **CALPITARIA** Jukes-Browne, 1908, p. 155

Type species.—*Callista sulcataria* Deshayes, 1825a, by original designation. Eocene, (lower Lutetian) of the Paris Basin.

Diagnosis.—Differing from *Pitar s.s.* in having a short, wide, rounded pallial sinus.

Remarks.—The subgenus is restricted to the Eocene of the northern hemisphere.

Pitar (Calpitaria) turneri, new species
Plate 7, figures 1–2

Description.—Shell medium in size, height about 89% of length, width (of single valve) about 31% of height, umbones prominent, tip enrolled, and anterior at about 17% of the length. Anterior end quite sharply rostrate, ventrally smoothly curved, the posterior end rounded, straighter dorsally. Escutcheon not observed, lunule large, defined by an inpressed line, about twice as long as high. Juvenile sculpture of somewhat irrregular rounded lines. Adult sculpture of prominently wrinkled, close-set lines, sometimes bifurcating, essentially constant in strength over the shell surface except within the lunule where the wrinkled character disappears. No left valves found. Hinge of right valve with a strongly bifid cardinal 3b tooth, a strong triangular cardinal 1 tooth and a prominent thin projecting cardinal 3a tooth, both 3a and 1 projecting more than the other teeth. Two moderately sized pits above and below the anterior end of tooth 3a, anterior lateral very poorly defined, right posterio-dorsal valve margin grooved. Pallial sinus fairly short and stubby, the end rounded, anterior muscle-scar gourd-shaped with the neck pointing towards the pallial line.

Remarks.—At least three species of *Calpitaria* are found in the Reklaw but this is the only species that is well enough preserved for description. The two projecting cardinal teeth, 3a and 1, are a feature also seen in the Weches species *Pitar (Calpitaria) texacola* (Harris, 1919). That latter species, although shorter than *P. (C.) turneri* does show some irregularity in the undulations on the rostral area. Another similar species is *Pitar (Calpitaria) petropolitanus* Stenzel and Krause, 1957, which is restricted to the Cook Mountain Formation, that species has a sculpture of close-set, flat-topped comarginal ribs sometimes restricted to the shell margins, deep sockets anterior to teeth 3a and 3a and tooth 1 almost equal in size. One could surmise *P. (C.) turneri* is the ancestor of *P. (C.) texacola* but this appears unlikely as the author has an undescribed, very elongate Weches species from Burleson Bluff with the same unique external sculpture as *P. (C.) turneri.*

Etymology.—Honoring previous Reklaw worker F. E. Turner.

Type information.—Holotype: right valve, PRI 33086; paratype: a juvenile right valve, PRI 33087. Type locality: locality 4.

Material examined.—Two specimens, one juvenile, both right valves. The adult 30.2 mm in length, height 27.0 mm, width 8.3 mm, umbones at 17% of length.

Pitar (Calpitaria?) sp.
Plate 7, figs. 3–6

Remarks.—Numerous small juveniles, or "spat", were obtained of a species of *Pitar.* No intermediate sized specimens were found between the adult size of *Pitar (Calpitaria) turneri* n. sp. and these juvenile ones, so an assignment to that latter species cannot be made with confidence. However, the hinge features of both species show many similarities, and the assignment to the genus is assured after comparison with growth series of other *Pitar* species. The shell outline alon can distinguish these from other small Reklaw bivalve species.

Material examined.—21 specimens, the largest 1.36 mm. Figured specimens, a right valve: PRI 33132, a left valve: PRI 33133, from locality 4.

Subgenus **KATHERINELLA** Tegland, 1929, p. 280

Type species.—*Callocallista arnoldi* Weaver, 1916, by original designation. Oligocene of western Washington.

Diagnosis.—Shell thin, ovate, orbicular or subquadrate in outline. Beaks slightly elevated, prosogyrate, posterior dorsal margin almost straight. Sculpture with concentric growth lines and close-set concentric threads rounded on top, obsolescent at the escutcheon angulation. Lunule outlined by an impressed line and centrally swollen. Hinge like *Pitar* but left valve with an elongate anterior lateral tooth (AII) far forward and near the upper margin of the hinge plate.

Remarks.—Oligocene, western North America, Eocene of Gulf Coastal Plain. Recent.

Pitar (Katherinella?) sp. A
Plate 7, figure 13

Description.—Shell thin, orbicular with fairly pronounced prosogyrate beak. Margin anteriorly and ventrally evenly rounded, posterior-dorsally straighter. Sculpture with very fine and even concentric rounded threads, about 20 per mm, many of which coalesce as they approach the margins. Lunule very indistinct, defined by a colored line.

Remarks.—The only specimen is cemented to a block of matrix so that the hinge characters cannot be observed. Its external features closely resemble the Stone City Member species *Pitar (Katherinella?) texitrina* Stenzel and Krause, 1957. Another much larger species with a similar outline is *Pitar (Katherinella?) trigoniata bastropensis* (Harris, 1919); Palmer and Brann (1966), list this species from Devil's Eye, a locality believed assignable to the Queen City Formation or upper Reklaw Formation. The much finer concentric threads and indistinct lunule can distinguish this species from other Gulf coast *Katherinella* species.

Material examined.—One specimen a left valve, length: 12.3 mm, height: 12.3 mm Figured Reklaw specimen from locality 20, PRI 33088.

Pitar (Katherinella?) sp. B
Plate 7, figure 14

Remarks.—Two individuals, possibly from the same lot noted by Stenzel et al. (1957, p. 137), from Devil's Eye were examined and found to have external sculpture similar to *Pitar (Katherinella?) trigoniata* var. *bastropensis* (Harris, 1919). In neither specimen is the hinge available for study so a definite generic determination cannot be made. It is easily distinguished from species A by the coarser ornamentation and trigonal outline.

Material examined.—Figured specimen: TMM 84819, length 22.0 mm. Figured Reklaw specimen from locality 11.

Order **MYOIDA** Stoliczka, 1870, p. xv

Suborder **MYINA** Stoliczka, 1870, p. xv

Superfamily **MYOIDEA** Lamarck, 1809, p. 319

Family **CORBULIDAE** Lamarck, 1818, p. 536

Subfamily **CORBULINAE** Lamarck, 1818, p. 56

Genus **CARYOCORBULA** Gardner, 1926, p. 46

Type species.—*Corbula alabamensis* I. Lea, 1883, by original designation. Claibornian Eocene of the Gulf and Atlantic coastal plains.

Diagnosis.—Shell small or of moderate size, acutely keeled posteriorly; slightly inequivalve; right valve a little larger and higher relatively than the left; both valves concentrically rugose, the sculpture of the right valve in some species stronger and more regular than the left; a microscopically fine radial lineation developed in some of the larger species, particularly on the posterior keel; ligament, dental, muscle, and sinus characters similar to that of *Corbula* s.s.

Remarks.—Recent representatives are suspension feeders, worldwide in distribution but more abundant in warmer waters; commonly found below the tidal level; the animals are burrowers. The genus is known from the Upper Cretaceous to Recent.

Caryocorbula marquezensis, new species
Plate 7, figures 15–18

Description.—Shell small, solid and stongly inflated. The sculpture consists of concentric ribs, that are flattened towards the margins and sharply ridged towards the umbo; umbones central at about 34% of length, umbonal area set off by a sharp ridge. Right valve cardinal tooth is flattened parallel to the hinge line and curves towards the umbones. Valve margins on both sides of the rostrum concave. Pallial sinus broad and moderately deep. Left valve with two small teeth on the margin next to the resilium pit. Posterior extremity concave.

Remarks.—The closest described form is *Caryocorbula deusseni* (Gardner, 1924) which ranges from the Weches Formation to the Stone City Member. *C. deusseni* is larger, more elongate, has regularly rounded ribs that are placed irregularly on the surface, has a conical right valve cardinal tooth, and a rostrum pinched inwards at the dorsal margin.

Etymology.—The specific name refers to the Marquez member.

Type information.—Holotype: right valve, PRI 30300; paratypes: right valve and left valve, PRI 30303,30304. Type locality: locality 20.

Material examined.—21 specimens. Dimensions: largest right valve, 6.1 mm length, 3.8 mm height, 1.7 mm width. Largest left valve, 6.1 mm length, 4.3 mm height, 1.9 mm width. Mean ratios: right valves: height/length .75, width/height .45, left valves: height/length .72, width/height .43.

Genus **NOTOCORBULA** Iredale,
1930, pp. 404–405

Type species.—Notocorbula vicaria Iredale, 1930, by original designation. Recent off the coast of New South Wales, Australia.

Diagnosis.—Right valve larger, margins grooved for the insertion of the left valve. Umbones inflated, relatively low, capped by nepionic valves, both valves rostrate posteriorly into a snout. Umbonal keel strong, extending to the posterior-ventral margin with another weaker keel extending to the dorsal side of the posterior margin; area between the keels concave. Right valve with strong concentric ribbing, the left valve with weaker ribbing. Right valve with a prominently "keeled" anterior cardinal, a small resilium pit; left valve with a bipartite chondrophore. Adductor scars large and prominent; pallial sinus small, almost vertical.

Remarks.—The genus is known only from the Eocene and Recent.

Notocorbula marquezensis, new species
Plate 8, figures 1–5

Description.—Shell small, heavy, strongly inflated. Posterior end of right valve moderately rostrate and obliquely truncate, the posterior dorsal margin curving back sharply from the rostrum. Rostrum extended into a prominent rectangular snout. Cardinal tooth triangular in cross section, rounded below, sharp above and upturned towards the umbones. Nepionic portion of valve smooth or almost so, remainder with coarse flattened folds and occasional smaller intermediate ones. Left valve with much more subdued sculpture and a prominent resting stage between the nepionic and adult areas of the shell forming a distinct cap. Posterior muscle scar thickened prominently and elevated into the interior.

Remarks.—The only other species of *Notocorbula* described from the Gulf Coastal Plain is *Notocorbula texana* (Gabb, 1860) from the Stone City Member of Texas. The Stone City specimens have more regularly rounded primary ribs with few intermediate secondary ones and a more cylindrical cardinal tooth. The most noticeable features differentiating the Reklaw specimens from *N. texana* are the rounder outline, the pinched character of the ribs as they cross over the rostral ridge, giving the appearance of a weak, rounded, radial rib, and the greater attendant change of angle there. On the left valve the elevated muscle scar situated on a platform can immediately distinguish it from the Stone City species.

Type information.—Holotype: right valve, PRI 30305; paratypes: one right valve, two left valves and one double valve, PRI 30306–30308. Type locality: locality 20.

Material examined.—400+ specimens: right valves: the largest, 7.5 mm length, 5.8 mm height, 3.1 mm width. Left valves: the largest, 5.8 mm length, 4.6 mm height, 2.4 mm width. Double valves: the largest 6.1 mm length, 5.1 mm height, 4.2 mm width. Mean ratios: right valves: height/length .81, width/height .55; left valves: height/length .83, width/height .53; double valves: height/length .81, width/height .91.

Superfamily **HIATELLOIDEA** Gray, 1824, p. 60

Family **HIATELLIDAE** Gray, 1824, p. 60

Genus **PANOPEA** Menard, 1807, p. 135

Type species.—Mya glycymeris Born, 1778 (= *Panopea faujas* Menard, 1807), by subsequent designation (Schmidt, 1818, p. 177). Recent in the Mediterranean.

Diagnosis.—Shell usually large, inflated, equivalved, beaks subcentral, usually gaping at both ends. Surface smooth or concentrically furrowed. Ligament-

al nymph large and high. A single prominent conical tooth in each valve. Pallial sinus wide and deep.

Remarks.—The genus is known from the Upper Cretaceous to Recent, where it usually occurs in cooler waters.

Panopea? sp.
Plate 8, figure 6

Remarks.—Four specimens comprising at least two species of *Panopea* sp. have been found in the Reklaw deposits. In one of them the shell is very thin and quadrate in outline, the other is more elongate and rounded. As the hinge is not visible they could not be subgenerically differentiated. The commonest form is the second mentioned and is figured.

Figured specimen.—A right valve, from location 7, PRI 30481.

Suborder **PHOLADINA** H. and A. Adams, 1856, p. 323

Superfamily **PHOLADOIDEA** Lamarck, 1809, p. 319

Family **TEREDINIDAE** Rafinesque, 1815, p. 148

Subfamily **BANKININAE** Turner, 1966, p. 57

Genus **BANKIA** Gray, 1842, p. 76

Type species.—Teredo bipalmulata Lamarck, 1801, by subsequent designation (Gray, 1847a, p. 188). Recent in the Indo-Pacific.

Diagnosis.—"Pallets greatly elongate, blade composed of numerous cone like elements on a central stalk, cones separate and easily removed from the stalk, particularly in dried specimens. Cones with calcareous base covered with periostracum which extends as a border. The width and ornamentation of the periostracal border varies greatly; it may be smooth, coarsely to finely serrated, or produced laterally as awns. Siphons fairly long and serrated. Young not retained with the parent." (Turner, 1966, p. 80).

Remarks.—Turner (1966, p. 61) cites the results of several studies demonstrating the difficulty of using shell characters to identify species of Teredinidae, concluding it is often not possible to determine the genus without knowledge of the nature of the pallets. The genus is known from the Paleocene to Recent.

Subgenus **LYRODOBANKIA** Moll, 1941, p. 200

Type species.—Nausitora kamiyai Roch, 1931, by subsequent designation (Turner, 1966, p. 108). Recent, temperate and tropical seas.

Diagnosis.—Pallet margin smooth, equal width on both inner and outer faces, produced laterally into short blunt points. Embryonic cones closely packed and covered by periostracal cap.

Remarks.—Prior to this report the genus was only known from the Recent.

Bankia (Lyrodobankia) petalus, new species
Plate 8 figures 7–10

Description.—Shell gently rounded from the anterior-dorsal side to a more sharply rounded ridge parallel to the posterior slope. The posterior slope is broad and rectangular, the lines of growth initially parallel to the shell's dorso-ventral axis, swinging round as they meet the main body of the shell at right angles and then swinging back again to continue obliquely along the disc as low irregular undulations. Umbonal-ventral sulcus with exceedingly fine radial ridges which are themselves crossed by microscopic impressed striae forming a minute lattice pattern. Anterior slope with flat-topped denticulate ridges, spaced wider medially than dorsally or ventrally and bounded posteriorly by a thickened ridge. Cardinal tooth tubular, extending almost the entire interior length of the shell in a shallow arc. Pallets smooth, distal cross-section compressed-rhombohedral, one side smoothly rounded, the other more pointed due to a slight medial carina. On the carinate side, the pallets are laterally produced to a rounded petal-like outline which on the other side converges as a low V, the apex near the expansion point of the tube. Distance between successive pallets about the same as the maximum pallet diameter.

Remarks.—Specimens of free valves are rare in early Tertiary deposits, this set and another two single valves from the Cook Mountain Formation collected by the author being the only ones known from the Eocene of the Gulf or Atlantic Coastal plain. Pallets are required to distinguish to generic or subgeneric level and they have only been found in a few instances. Turner (1966, pp. 14–17) lists two occurrences from North America, one from the Paleocene of North Dakota and the other from the Oligocene of Washington; several more have been found in western Europe. Both primary Reklaw localities have yielded tubes with pallets, in each case the tubes with pallets were found in immediate proximity to the fossilized wood specimen, but not within it. The tubes have a smooth exterior, are crowded closely together, the whole mass very convoluted. The interior of the tubes was filled with a soft, microscopically fibrous material, with the valves at one end and the pallets close to the valves, a condition which according to Turner often happens during death or disturbance of the animal. Even more unusual was the discovery of a very thin sheaf covering the pallets; this was broken in the preparation but can still be seen in places, and is surmised to be the remnants of the periostracum. The carbonized remains of one animal was even found in the interior

of one double valve. According to Turner (1966, p. 32) the young are not retained with the parent; this was perhaps not the case in Eocene times as excavation of one tube revealed two minute valves between the pallets and the shell. All previous species of *Bankia* from the Gulf and Atlantic coastal plain are all described from the tubes, which are notoriously variable in character. Three species of *Bankia,* whose preservation warrants a comparison are *Bankia maverickensis* (Gardner, 1923), from the Kincaid Formation, *Bankia emacerata* (Whitfield, 1885), from the Shark River Formation, and *Bankia ringens* (Aldrich, 1921), from the Wills Points Formation. *B. maverickensis* is described as occurring in fossilized wood, and has a closely wrinkled surface; *B. emacerata* is also described from fossilized wood and has tubes that taper rapidly towards the apex; *B. ringens* has tubes with raised thickened rings, set virtually at right angles to the axis. The remainder of the *Bankia* species are described from such poor material as to make a comparison difficult.

Etymology.—Referring to the resemblance of the margin of the pallets to petals.

Type information.—Holotype: a tube with pallets, PRI 33125; paratypes: PRI 33090–33095. Type locality: locality 7.

Material examined.—Seven specimens of valves, two partial pallet sets, three separated pallets, and numerous tubes in fossilized wood. Largest free valve pair: diameter 2.5 mm, largest free pallet: 1.52 mm length, 1.14 mm width.

Subclass **ANOMALODESMATA** Dall, 1889b, p. 64

Order **PHOLADOMYOIDA** Newell 1965, p. 21

Superfamily **PHOLADOMYOIDEA** Gray, 1847, p. 187

Family **PHOLADOMYIDAE** Gray, 1847, p. 187

Genus **PHOLADOMYA** G. B. Sowerby, 1823a[3]

Type species.—Pholadomya candida G. B. Sowerby, 1823a, by subsequent designation (Gray, 1847, p. 194). Recent, southeastern West Indies.

Diagnosis.—Shell medium sized to large, thin, nacreous. Outline ventricose, transversely ovate-trigonal to subquadrate, gaping posteriorly. Umbones anterior, prominent, escutcheon faint, often defined by flattening of the shell or disappearance of the sculpture. Surface microscopically pustulose, ornament usually strong, both radially and concentrically, at the intersections more or less noded. Hinge edentulous, ligament external, pallial sinus broad and moderately deep.

Remarks.—The genus was most diverse in the late Mesozoic and has declined steadily since. Six species are known from the Paleogene of the Gulf Coast, two in the Recent fauna.

[3] On unnumbered page 228.

Pholadomya cf. **leonensis**,
Stenzel and Twining, 1957
Plate 8, figures 11–12

Pholadomya leonensis Stenzel and Twining, 1957 *in* Stenzel, Krause, and Twining, 1957, p. 164, pl. 18, fig. 13; pl. 19, figs. 4, 5.

Remarks.—These specimens are preserved as clay molds with fragments of attached shell, one partial valve with exterior cemented to matrix was also found. Due to the distortion no meaningful comparison can be made with the outline of other species. The few fragments of shell remaining show a microscopic pustulose surface similar to that seen in *Pholadomya leonensis* Stenzel and Twining, 1957 from the Weches Formation. Another feature seen in *P. leonensis* is the almost complete absence of radial folds except close to the umbo; the valve fragment shows this feature.

Material examined.—Four molds and one incomplete valve. The largest specimen: 24 mm length, 14 mm maximum height, 18 mm double valve thickness.

Type information.—Holotype: TBEG 20550. Type locality: North ditch of old abandoned Concord-Centerville county road, 0.6 mile southeast of dismantled Robbins depot, Texas Bureau of Economic Geology location, 145-T-1. Figured Reklaw specimen: PRI 33096, from locality 4.

Superfamily **PANDOROIDEA** Rafinesque, 1815, p. 20

Family **PERIPLOMATIDAE** Dall, 1895, p. 528

Genus **COCHLODESMA** Couthouy, 1839, p. 170

Type species.—Anatina leana Conrad, 1831, by subsequent designation (Hermannsen, 1847, p. 266). Recent, northeastern coast of North America.

Diagnosis.—Lenticular, subequilateral; lithodesma present, chondrophore buttressed. Surface smooth or minutely scabrous, with a fine epidermis.

Remarks.—An uncommon genus, found in boreal to temperate waters at moderate depths. The genus is known from the Miocene to Recent.

Subgenus **COCHLODESMA** Couthouy, 1839, p. 170

Diagnosis.—"Slightly inflated, surface not granulose; lithodesma cartilaginous" (Keen *in* Moore, p. N850).

Cochlodesma (Cochlodesma) ovalis, new species
Plate 8, figure 15

Description.—Shell, small, very thin, ovate, anteriorly larger. Surface smooth or irregularly concentri-

cally plicate, overridden with lines of growth, medially obsolescent, stronger on both ends of the shell. Interior nacreous, pallial sinus and muscle scars not visible, chondrophore thin and spoon-shaped.

Remarks.—To date *Cochlodesma* has not been recognised as a fossil earlier than the Miocene. Gardner (1943) lists just one species, *Cochlodesma antiqua* (Conrad, 1834) from the Yorktown Formation of North Carolina. As fossils, representatives of the genus *Cochlodesma* may be distinguished from those of the closely similar genus *Periploma* by the combination of the smooth rather than granular surface and the more regularly ovate outline. One double valve, but flattened specimen shows the remnants of the lithodesma in the chondrophore cup. The rounded outline of *C. ovalis* is closer to that of the the type of *Cochlodesma leanum* than the Miocene species *C. antiqua*. Both periplomatid genera *Cochlodesma* and *Periploma* are commonly found in the Weches and Cook Mountain formations in east Texas although usually in a fragmentary condition.

Etymology.—Referring to the ovate outline.

Material examined.—11 specimens, the largest complete: 13.5 mm length, 8.7 mm height. The length of one fragmentary specimen is estimated at 76 mm.

Type information.—Holotype: a right valve, PRI 33097; paratype: PRI 33098. Type locality: locality 4.

Superfamily **POROMYOIDEA** Dall, 1886, p. 292

Family **CUSPIDARIIDAE** Dall, 1886, p. 292

Genus **CARDIOMYA** A. Adams, 1864, p. 330

Type species.—Cardiomya gouldiana Hinds, 1843, by monotypy. Recent, Sea of Japan.

Diagnosis.—Shell radially ribbed on the main part of the shell, rostrum smooth; similar to *Cuspidaria* but with more prominent fossette, thinner septum and prominent radial sculpturing. Right valve with a prominent posterior lateral tooth.

Remarks.—Unlike most Cuspidariidae, Recent species of this genus prefer shallow water. The genus is known from the Upper Cretaceous to Recent.

Cardiomya fredsmithi, new species
Plate 8, figures 16–17

Description.—Shell very small, ovate triangular, highly inflated, umbones central and enrolled. Sculpture of 16 strong, slightly irregular placed ribs, small and close-set anteriorly and becoming larger and further apart towards the posterior margin. Umbonal slope weakly defined and with three larger ribs. The ribs are crossed by regular concentric rounded lines, the interstices wider than the lines and the intersections of the lines with the ribs tending to become nodular near the ventral margin. Hinge line short and straight, one upturned cardinal tooth.

Remarks.—At first sight this species is reminiscent of *Verticordia eocenensis* Langdon, 1886 from the Gosport Sand Formation, but genus *Verticordia* all have a nacreous interior. *C. fredsmithi* belongs to the small group of *Cardiomya* spp. with a very truncated rostrum, of which *Cardiomya attenuata* (Aldrich, 1886), from the Lisbon Formation at Claiborne Bluff, Monroe County, Alabama, *Cardiomya (Cardiomya)* sp. Perrilliat (1984, p. 22, pl. 20) from the Miocene of Mexico, and *Cardiomya curta* Jeffreys, 1881, Recent of the Eastern Pacific are representatives. The closest species is perhaps *C. attenuata* which is also covered with fine concentric lines. The Reklaw species is distinguished from the others primarily by its almost obsolete rostrum and the presence of radial ribs over the entire surface.

Etymology.—The species is named in honor of Professor Fred Smith, a distinguished worker in Texas geology, and whose publication (Smith, 1962) was instrumental in causing the author to examine Joe Taylor Branch.

Type information.—Holotype: a left valve, PRI 30482. Type locality: locality 20.

Material examined.—Four specimens and two large fragments. The largest 3.0 mm length, 3.0 mm height, 1.3 mm width, umbones central.

Cardiomya sp.
Plate 8, figure 18

Remarks.—A second species is represented here by three incomplete specimens. The best one is an impression in matrix with some fragments of attached shell material. The species is very thin-shelled, surface smooth with 13 sharp radial ribs, closely spaced anteriorly, widest just prior to the smooth rostrum. The species is very close to an undescribed species from the Cook Mountain Formation where it is reasonably common. Larger specimens show an unequal development of ribs; a feature also seen on large Cook Mountain specimens.

Material examined.—Three fragments. The one complete impression: 5.6 mm in length, 2.0 mm height.

Figured specimen: A right valve, from location 7, PRI 30538.

Family **VERTICORDIIDAE** Stoliczka, 1871, p. 224

Genus **VERTICORDIA** J. de C. Sowerby, 1844b, pl. 639

Type species.—Hippagus cardiiformis J. de C. Sowerby, 1844b, by monotypy. Coralline Crag (Plio/Pleistocene) of England.

Diagnosis.—Shell small, inflated, with nacreous interior and usually ornamented with strong curved ribs. Ligament internal with large lithodesma.

Remarks.—The genus lives primarily in deep water. Palmer and Brann (1965), list 11 species from the Paleogene of the southern and eastern United States. The genus is known from the Paleocene to Recent.

Subgenus **TRIGONULINA** d'Orbigny, 1846, p. 291

Type species.—Trigonulina ornata d'Orbigny, 1846, by monotypy. Recent in the Caribbean and eastern Pacific.

Diagnosis.—"Shell laterally compressed with prominent radial ribbing, lithodesma long and flat. Right valve with strong lateral tooth, left valve edentulous. Interior brilliantly nacreous." (Bernard, 1974, p. 115).

Remarks.—The species of this subgenus live in shallower water than *Verticordia* s.s. Intensive collecting in the Claibornian suggests *Trigonulina* is much rarer than *Verticordia* s.s.

Verticordia (Trigonulina) cf. **satex** Gardner, 1927
Plate 8, figures 13–14

Verticordia satex Gardner, 1927, p. 367, figs. 22, 23.
Verticordia (Trigonulina) satex Gardner, Stenzel, Krause, and Twining, 1957, p. 178.

Original description.—"Shell highly nacreous, small, compressed, subtrigonal in outline, inequilateral. Umbones sub-central, incurved, strongly prosogyrate. Margin directly in front of the umbones deeply excavated by the false lunule. Escutcheon absent. Anterior extremity strongly arcuate, posterior dorsal and lateral margins forming a parabolic curve from the umbones to the arcuate base. Outer surface heavily corded with 14 subequal, abruptly elevated ribs radiating from the umbones in gentle curves, convex posteriorly, more widely spaced medially but with no sharp breaks in the spacing; interradials deeply concave and wider than the radials; entire surface microgranular; outer margins sharply dentate. Ligament opisthodetic, deeply inset, continuing to the apices of the umbones. A single, rather stout, sub-umbonal cardinal developed in the right valve, received in the left valve between the dorsal margin and the thickened inner margin of the lunule which functions as a denticle; posterior margin of right valve grooved to receive the bevelled margin of the left. Anterior muscle scar small, elongate, quite deeply sunken, its dorsal extremity beneath the ventral margin of the false lunule, posterior muscle scar obscure, pallial line remote from the margin, distinctly impressed. Dimensions: Altitude, 3.0 millimeters; latitude, 3.0 millimeters; semi-diameter, 0.7 millimeter." (Gardner, 1927, p. 367).

Remarks.—The Reklaw specimens have one or two fewer ribs than Gardner described, are about half the size and are not so trigonal in outline. Because the valves may be juveniles and a little worn it seems best not to describe them as new here. Two right valves were obtained. The only other known Paleogene representative of *Trigonulina, Verticordia (Trigonulina) sotoensis* Aldrich, 1903b, from the Cook Mountain Formation of Mississippi, is differentiated by the unequal spacing of the ribs.

Material examined.—Two specimens, the largest, 1.65 mm length.

Type information.—Holotype: USNM 369240. Type locality: Stone City Bluff, Burleson County, Texas. Figured Reklaw specimen, a right valve: PRI 33099, from locality 4.

Class **SCAPHOPODA** Bronn, 1862, p. 523

Order **DENTALIIDA** da Costa, 1776, p. 152

Family **GADILINIDAE** Chistikov, 1975

Genus **EPISIPHON** Pilsbry and Sharp, 1897, p. 127

Type species.—Dentalium sowerbyi Guilding, 1834, by subsequent designation (Suter, 1913, p. 821). Recent off the coast of the Southeastern United States and the West Indies.

Description.—Shell very small, very slender, needle-like, circular, moderately curved, surface smooth except for growth rings that are most conspicuous on the posterior part of the shell; apex having a short projecting tube or a wide narrow U-shaped lateral notch.

Remarks.—Living species are mainly inhabitants of deep water. The genus ranges from the Lower Jurassic to Recent.

Episiphon gracilis, new species
Plate 9, figure 7–8

Description.—Shell small, smooth, glassy, gently and regularly curved. Apertural cross-section rounded-triangular with the apex ventral; the sides of the triangle between 55–60°, apical end ovate. Orifice close to the ventral face, elliptical in outline, the major axis vertical, usually becoming circular at the apical end.

Remarks.—This species is similar to *Episiphon acicula* (Hodgkinson, 1974) from the Wheelock Member of the Cook Mountain Formation, but can be distinguished by the larger ventral angle of the triangular cross-section, the relatively thicker shell anteriorly and the more pronounced triangular outline. All specimens appear to be broken, even those which can be observed in situ within the matrix. Sediment compaction does not seem to be the cause, as that results in longitudinal

fractures in most cases while the observed fractures occur in a plane at right angles to the shell axis. The vast majority of breakages have occurred at the anterior end where the shell thickness decreases smoothly to less than .025 mm. It appears the animal must have added new shell material as a sharp rim, thickening the shell wall some distance behind the aperture. The largest specimen is 14 mm although many specimens must have been double that size. Numerous specimens from the type locality exhibit surface markings which are assumed to be the remains of the original color pattern; these are usually evenly spaced concentric rings but may also be longitudinal lines rather like an effaced, ribbed *Dentalium,* one specimen showing both concentric and longitudinal markings.

Etymology.—The specific name *gracilis* (Latin; thin, slender), refers to that characteristic of the species.

Type information.—Holotype: PRI 30310; paratypes: PRI 30311, 30312. Type locality: locality 4.

Material examined.—More than 150 specimens, the largest: 13.9 mm length, 1.4 mm maximum diameter.

Family **DENTALIDAE** Gray, 1847, p. 158

Genus **DENTALIUM** Linnaeus, 1758, p. 785

Type species.—Dentalium elephantium Linnaeus, 1758, by subsequent designation (Montfort, 1810, p. 23). Recent off Amboyna and the Philippine Islands.

Description.—Shell an enlarging curved tube; sculpture of longitudinal ribs at the posterior end that commonly extend the entire length of the shell. Apical, or posterior opening usually with a slit or notch; opening circular or oblique, sometimes modified by the longitudinal ribs.

Remarks.—The Recent animals are cosmopolitan in distribution, and feed on detritus with the apical end below the surface of the sea bottom. The genus is known from the Middle Triassic to Recent.

Subgenus **ANTALIS** H. and A. Adams, 1854, p. 457

Type species.—Dentalium antalis Linnaeus, 1758, by subsequent designation (Pilsbry and Sharp, 1897, p. 37). Recent off the Atlantic coast of Europe.

Original diagnosis.—"Shell small to medium-sized, circular or polygonal in section, less strongly ribbed than *Dentalium* s.s., longitudinal riblets commonly lacking in senescent stages, but present on apical portion of tube in juvenile stages; apical orifice generally with a V-shaped notch on or near the concave side and generally bears a solid plug with central pipe or orifice, rarely simple." (Emerson, 1962, p. 470)

Remarks.—The subgenus is known from the Pliocene to Recent.

Dentalium (Antalis) palmerae, new species
Plate 9, figure 2

Dentalium sp., Palmer, 1937, p. 18, pl. 1, fig. 11; Brann and Kent, 1960 p. 321; Palmer and Brann, 1965 p. 371.

Description.—The shell with ten or 12 sharp longitudinal ribs at the apex. Angle at apical notch about 80°. Single intermediate ribs develop, not always midway between the primary ribs, and rapidly approach the the primary ribs in size. Larger specimens may show up to four intermediate ribs. Primary ribs always define the vertices of a polygonal section. The entire pattern becomes obsolete and smooth with increasing age.

Remarks.—As is the case with *Dentalium (Antalis) thaloides* Conrad, 1833a, from the Gosport Sand Formation, the shell is much thicker posteriorly, the thicker portions surrounding an inner circular section. Palmer (1937, p. 18), described specimens she attributed to *Dentalium* sp. from the Cook Mountain Formation of Louisiana that appear to belong to the same species. The species also occurs in the Weches Formation at Smithville, Bastrop County, Texas.

Etymology.—This species is named after Dr. K. V. W. Palmer who first noted it.

Type information.—Holotype: PRI 30313, from locality 4.

Material examined.—150 + specimens or fragments, longest specimen: 23.4 mm length, 2.1 mm maximum diameter, largest diameter fragment: 2.4 mm.

Order **GADILIDA** Starobogatov, 1974, p. 13

Family **GADILIDAE** Stoliczka, 1868, p. 440

Subfamily **GADILINAE** Steiner, 1992, p. 398

Genus **CADULUS** Philippi, 1844a, p. 209

Type species.—Dentalium ovulum Philippi, 1844a, by monotypy. Miocene to Recent in Italy.

Diagnosis.—Shell small to medium in size with circular cross section, more or less arcuate with maximum inflation between the maximum diameter and the anterior end; aperture usually constricted. Surface smooth, vitreous or transparent, with minute longitudinal striae or annular rings. Apical orifice with two to four notches.

Remarks.—Their distribution is Cretaceous to Recent with more than 100 species known today.

Cadulus (?) bisissura, new species
Plate 9, figure 3–5

Description.—Shell small, smooth or glassy. Shell arcuate with maximum inflation at about 60% of length, profile tapering to a small circular apical end which is characterized by a shallow V-shaped notch

on the ventral side and a rounded notch on the dorsal side. Apertural shape a flattened ellipse with the major axis dorsal-ventral; major/minor axis ratio about 1.3.

Remarks.—The only perfect specimen is now unfortunately broken but still shows the apertural characteristics. The shell profile and aperture shape place this species close to *Cadulus (Gadila) erleneae* Hodgkinson, 1974, from the Wheelock Member of the Cook Mountain Formation. The apical notches and position of maximum inflation can differentiate the two species. The shape of the aperture can distinguish both *Cadulus bisissura* and *C. (G.) erleneae* from other Tertiary Gulf coast species. The two shallow apical notches do not correspond satisfactorily to any of the subgenera discussed by Emerson (1962). Subgenus *Platyschides* Henderson, 1920, is a similar taxon possessing similar very shallow notches.

Etymology.—From the Latin for two-notched.

Type information.—Holotype: PRI 30314, 3 mm. length; paratype: PRI 30315. Type locality: locality 4.

Material examined.—Ten specimens, the largest: 3.4 mm length, 0.66 mm maximum diameter.

Cadulus spp.

Remarks.—Broken fragments indicate at least three other *Cadulus* species occurring in the Reklaw, one species highly inflated and similar to *Cadulus (Gadila) ouachitensis* Palmer, 1937, another with a very rapidly contracted apertural end similar to *Cadulus ("Dischides") abruptus* Meyer and Aldrich, 1886, and the third, figured in plate 9, figure 6, from locality (PRI 33121), with affinities to *Cadulus (Polyschides) subcoarcuatus* (Gabb, 1860), cf. pl. 9, fig. 6. More material needs to be found for further separation.

Class **GASTROPODA** Cuvier, 1797, p. 378

Subclass **PROSOBRANCHIA** Edwards, 1848, p. 191

Order **ARCHEOGASTROPODA** Thiele, 1925, p. 74

Suborder **NERITIMORPHA** Golikov and Starobogatov, 1975, p 209

Superfamily **NERITOIDEA** Rafinesque, 1815, p. 144

Family **NERITIDAE** Rafinesque, 1815, p. 144

Genus **THEODOXUS** Montfort, 1810, p. 351

Type species.—Nerita fluviatilis Linnaeus, 1758, by original designation. Recent in the Eastern Atlantic Ocean.

Original Diagnosis.—"Coquille libre, univalve, à spire regulière, écrasée; point d'ombilic; bouche entière, arrondie, évasée, perpendiculaire à l'horizon; lèvre extérieure trenchant; nulle dent à cette lèvre ni à la collumella." (*Translation.*—Shell free, univalve; the spire regular, squat, apex depressed; aperture entire, circular, flaring, perpendicular; exterior rim sharp; no tooth on the rim of the columella.).

Revised Diagnosis.—Shell small or very small, ovate to hemispherical, spire moderately high, rarely squat. Outer lip sometimes weakly flaring, not toothed; septum smooth, columella edge smooth or finely toothed. Operculum smooth, apophysis weakly formed.

Remarks.—Theodoxus, in common with other members of the Neritidae often have strongly marked color patterns, and according to Russell (1941, p. 355) the presence of color *per se* is of little taxonomic value although the color pattern often is. Modern representatives of the genus are herbivorous and usually prefer estuarine to freshwater conditions. Prior to this occurrence *Theodoxus* has not been known earlier than the Oligocene. One of the earliest representatives is *Theodoxus apertus* (J. de C. Sowerby, 1823b) from the Oligocene Headon Beds, Isle of Wight in England. The genus is particularly well represented from the Miocene to Recent in central Europe and the Middle East.

Theodoxus domicilium, new species
Plate 9, figures 23–24

Description.—Shell small and globose. Protoconch not visible, being covered by a broad flat callus pad, at the bottom of a shallow cylindrical depression. The depression is formed by the side of the whorl initially rising above the pad and then descending again on the final whorl; sides straight and the rim sharp. Suture impressed and bordered below by a small depression, giving the whorl a slightly shouldered profile. Surface glossy with fine curved lines of growth and retaining a color pattern of irregular wavy lines curving back from the sutural region, forward again past the mid point of the whorl and then showing one or two smaller undulations below. Aperture ovate, outer lip sharp, columella septum thin, straight and smooth. Callus broad and thin.

Remarks.—The absence of teeth or an apophysis preclude placing this specimen in the *Neritina* group, and although the remaining characters place it in genus *Theodoxus,* the spire depression is atypical. This family is very rare in the American Gulf Coast Eocene, only one specimen having been described so far, *Neritina unidentata* Aldrich, 1911 from the Lower Eocene Hatchetigbee Formation. The author has another six specimens of neritids from the Eocene of Alabama and Texas but none of those can be assigned to *Theodoxus. Theodoxus* is rare today in the U.S.; Abbott (1974) records only one species, *Theodoxus (Vittoclithon) lu-*

teofasciata Miller, 1879 and a Miocene representative of *Theodoxus* has been reported recently by Smith (1986) from Baja California. A similar spire depression is also seen in many specimens of *Neritina virginica* (Linnaeus, 1758).

Etymology.—The specific name *domicilium* (Latin, house), refers to the atypical callus pad (vernacular for house).

Type information.—Holotype: PRI 30328. Type locality: locality 20.

Material examined.—One specimen, 5.0 mm in width.

Order **CAENOGASTROPODA** Cox, 1960, p. I311

Suborder **NEOTAENIOGLOSSA** Haller, 1882

Superfamily **CERITHIOIDEA** Fleming, 1822, p. 491

Family **LITIOPIDAE** Gray, 1847a, p. 155

Genus **LITIOPA** Rang, 1829, p. 306

Type species.—*Litiopa melanostoma* Rang, 1929, by original designation. Pelagic on floating seaweed.

Diagnosis.—Shell small, elongate-conic, whorls smooth or with fine spiral lines that are stronger basally. Protoconch very small and axially striate. Body whorl about half the length of the shell. Aperture entire, oval-elongate; columella concave, strongly ridged anteriorly; outer lip thin, weakly basally notched.

Remarks.—Recent species of *Litiopa* are much thinner-shelled than all Eocene or Oligocene species that were examined. The genus is epifaunal on floating algae, particularly *Sargassum.* Well preserved specimens from the early and middle Claibornian can be recognized by the minute vertical striae on the protoconch. Without the diagnostic sculpturing on the protoconch whorls, specimens could be confused with *Astyris,* a genus known from the Eocene to Recent and primarily found in northern seas.

Litiopa texana, new species
Plate 14, figures 13–14

Description.—Whorls eight, protoconch of four whorls, the first two smooth, inflated and slightly flattened, the next two with minute close-set parasigmoidal threads crossed by three spiral threads. Adult sculpture begins sharply, whorl profile almost flat and with eight to nine close-set flattened ribs, the two ribs bounding the channeled suture being the most prominent. Outer lip smooth, crenate within, and sharp-edged; aperture rounded, rhombohedral. Margin of labrum concave and margined below by a slight swelling, canal straight-sided, strongly bent to the left, siphonal fasciole weak.

Remarks.—Specimens of this genus appear to be uncommon in the early Tertiary; Palmer and Brann (1966) list only two species from the Paleogene of the Gulf and Atlantic coastal plain. Two species are also known from the Eocene of the Paris Basin. Tracey (pers. comm.) reports finding specimens of *Litiopa* from the Eocene Bracklesham and Barton formations in England. Specimens of this genus are more abundant than the previous records would indicate, as I have found several specimens of a closely similar, and so far undescribed form from the Cook Mountain Formation. None of the previous descriptions of the Eocene species mentions the axial striations on the protoconch; Tracey (pers. comm.) reports that feature is present on all the Eocene Paris Basin and English specimens. All the English, French and Texas specimens have strong spiral lines on the protoconch with the vertical ribbing present in the interstices. The present species *L. texana,* can be separated by its flatter whorls, stronger spiral lines and shallower sutures. The unnamed Cook Mountain Formation species is shorter, with more inflated whorls, and weaker spiral sculpture. I am indebted to Steve Tracey for recognising the genus *Litiopa* in the Reklaw, and for communicating valuable information on the English and French species.

Etymology.—Noting the discovery of the genus in Texas.

Type information.—Holotype: PRI 30386; paratype: PRI 30387, a juvenile. Type locality: locality 20.

Material examined.—97 specimens, the largest: 5.0 mm length, 2.8 mm width.

Subfamily **BITTIINAE** Cossmann, 1906a, p. 61

Genus **BITTIUM** Leach in Gray, 1847b, p. 270

Type species.—*Murex reticulatus* Montague, 1803, by subsequent designation (Gray, 1847, p. 154). Recent in European seas.

Diagnosis.—Shell solid, small, slender and nodose. Protoconch with about two and a half smooth or spirally lirate whorls. Adult whorls flattish, usually three with noded spiral lines, axial ribs and irregular varices. Aperture ovate, inner lip concave, outer lip thin, smooth, not reflected, short anterior notch present, not reflected backwards.

Remarks.—Houbrick (1977) reevaluated the genus *Bittium* and found no justification for the separation into subgenera on conchological grounds alone, given the high degree of variability and cosmopolitan distribution seen in this genus. The genus ranges from the Paleocene to Recent.

Bittium tresquatrum, new species
Plate 10, figures 15–16

Description.—Shell solid, high, small, to 12 mm in length. Whorls about 16 in number, the first one or two nuclear whorls missing in all specimens found. First two extant whorls smooth, squat and medially carinate, the next two with two spiral lines, the anterior one developing first. Adult whorls moderately convex with about 18 to 22 broad longitudinal costae and one varix every three-quarters of a whorl, the whorls overridden by five broad flattened spiral cords, the posterior one margining the suture. The posterior three cords are larger and more prominently noded than the other two. The interstices between the cords with one to three fine spiral striae, the growth lines forming a broad open C. Basal disc present and margined by a sixth cord, the disc showing a few weak spiral lines. Aperture oval, outer lip with a varix in the adult, labrum with a few short lirae. Inner lip reflected with a moderately thick wash of callus, columella straight with one thin acute fold, short anterior notch present.

Remarks.—Bittium is an uncommon genus in the Eocene of the Gulf and Atlantic coastal plains. The previously known North American species can be split into two groups, the first, represented by subgenus *Stylidium* Dall *in* Bartsch, 1907, is characterized by generally smooth shells with weak or obsolete axial sculpture; the second group is represented by *Bittium koeneni* Meyer, 1886 from the Jackson Eocene, and *Bittium (Bittium) estellense* Aldrich, 1921 from the Paleocene of Alabama and Texas. These are very small species with angular whorls and axial nodose ribs. *B. tresquatrum* shows little similarity to either of the above groups, or even to the two west coast Eocene species, *Bittium longissimum* Cooper, 1894, and *Bittium (Semibittium) quadricingulatum* Palmer, 1923. A related Eocene species is *Bittium transenna* (Bayan, 1873), from the Paris Basin. *Bittium tresquatrum* exhibits a remarkable similarity to several species of *Argyropeza* Melville and Standen, 1901, figured in Houbrick (1980), which today includes five bathyal species of small vitreous-shelled cerithids. Dockery (1984) has recognized *Argyropeza* s.l. from the Oligocene of Mississippi. The protoconch of even the best specimen of *B. tresquatrum* is somewhat abraded and the very tip is lost so a complete comparison cannot be made; what remains certainly is very similar to several *Argyropeza* species. All the Taylor Branch specimens were found inside a deep fossilized burrow, probably made by a crab or shrimp, and all show evidence of abrasion; this species may have been a favored food of the original inhabitant of the burrow.

Etymology.—The specific name refers to the constant three-quarter whorl placing of the varices.

Type information.—Holotype: PRI 30331; paratypes: PRI 30332, 30333. Type locality: locality 4.

Material examined.—154 specimens, the largest 12 mm in height.

Bittium ridgei, new species
Plate 10, figures 10–11

Description.—Shell very small, slender, solid. Juvenile whorls unknown. Adult whorls bicarinate, straight-sided and ornamented with three heavy spirals that are coarsely nodular where they cross over equally-sized longitudinal ribs; occasionally ribs are moderately thickened, becoming small varices. Later whorls may develop intermediate threads between the spirals and below the suture. Basal disc delimited by a smaller spiral line, and between it and the base of the columella lip a few more spiral lines, one of which is larger and continues into the aperture as a fold. Columella bent to the left, base of aperture straight, slight spout or emargination present.

Remarks.—As with *Bittium tresquatrum* there do not seem to be any close relatives of this species in the Gulf or Atlantic coastal plain. Distantly related is *Bittium koeneni* Meyer, 1886 from the Jackson Eocene. The coarse sculpture, slender straight-sided whorls, and apertural shape are sufficient to distinguish this species from other *Bittium* species.

Etymology.—Referring to the type locality, Ridge Creek, Bastrop County, Texas.

Type information.—Holotype: PRI 30334; paratype: PRI 30335. Type locality: locality 4.

Material examined.—14 specimens, the largest (broken) specimen ca. 0.4 mm. locality: locality 4.

Family **TURRITELLIDAE** Lovén, 1847, p. 194

Subfamily **TURRITELLINAE** Lovén, 1847, p. 194

Genus **TURRITELLA** Lamarck, 1799, p. 74

Type species.—Turbo terebra Linnaeus 1758, by monotypy. Recent in the Indo-Pacific.

Diagnosis.—Spire elongate, protoconch of about one and a half smooth, glassy, turbinate whorls. Teleoconch whorls usually straight sided, sometimes somewhat concave or convex, always ornamented with spiral lirae, basal lira sometimes forming a strong carina or collar. Outer lip sinuous. The genus ranges from the Cretaceous to Recent.

Turritella turneri Plummer, 1933
Plate 11, figures 13–14

Turritella sp. Plummer, 1933, p. 625.
Turritella turneri Plummer, 1933, p. 815, pl. 10, figs. 10, 10a; Sten-

zel and Turner, 1940, p. 836, pl. 47, figs. 16, 17; Stenzel and Turner, 1943, Card no. 106, figs. 10, 10a, 16, 17 (syntypes).
Turritella mortoni turneri Plummer. Palmer, 1937, p. 195 in part, pl. 23, figs. 4,5.
Turritella dumblei turneri Plummer. Bowles, 1939, p. 304.

Original description.—"Apical angle 17 1/2°, sculpture consisting of five unequal spirals, anterior spiral the largest, shape of the whorl strongly convex, posterior whorl slope slightly longer than anterior." (Plummer, 1933, p. 815)

Remarks.—This species has so far not been found in the deposits of Joe Taylor Creek, but further east in the localities of Bastrop and Caldwell Counties it is reasonably common at certain levels. Stenzel, (1953, pp. 72, 78) notes the species is locally abundant in the Newby member of Cherokee County. Bowles (1939), regarded this form as a subspecies of *Turritella dumblei* Harris, 1895a, but it is in fact more closely related to *Turritella infans* Stenzel and Turner, 1940. A similar form that could also be referred to *T. turneri* occurs in the Weches Formation of Nacogdoches County, Texas at the cut made for the Nacogdoches Lake Dam; the Weches species has stonger beading on the spirals and a somewhat smaller subsutural spiral but is otherwise very similar.

Type information.—Syntypes: P5419, Plummer Collection TBEG. Type locality: locality 1. Forney and Nitecki (1976, p. 217) state there are four syntypes at the Field Museum in Chicago, FMNH-UC 57367, only one of which could be located. Figured Reklaw specimens: PRI 33122, 33123, from locality 7.

Material examined.—84 specimens, the largest 14 mm length, 4 mm maximum diameter.

Subfamily **PAREORINAE** Finlay and Marwick, 1937, p. 42

Genus **MESALIA** Gray, 1842, p. 61

Type species.—*Turritella brevialis* Lamarck, 1822, by subsequent designation (Gray, 1847a, p. 155). Recent off the coasts of Northern and Western Africa.

Diagnosis.—Spire elongate, usually cyrtoconoid. Teleoconch whorls rounded, often highly inflated, sutures not channeled or deeply impressed, ornamented with spiral striae or lirae, lines of growth arcuate, the points of contact with the suture closely in line with the shell axis. Aperture subcircular, slightly reflected anteriorly, anterior portion of outer lip recurved.

Remarks.—The genus ranges from the Upper Cretaceous to Recent.

Mesalia sp.
Plate 11, figure 15

Remarks.—A single specimen of a *Mesalia* sp. was found in the general collection of the Texas Memorial Museum. The preservation, shape and sculpture is similar to that seen in *Mesalia* specimens from the Weches Formation at Smithville and it is possible this is a misplaced specimen. The specimen is very close to *Mesalia claibornensis* Harris, 1895b, from which it differs by an apical angle which is two to three degrees larger and having more inflated whorls. The aperture had within it a sandy glauconite matrix and two juvenile specimens of *Limacina sp.*; the matrix is similar to other Reklaw deposits and the *Limacina* species are also commoner in the Reklaw than the later Weches deposits. With some doubt this specimen is believed to be of an age equivalent to that of the Reklaw. Further collecting could resolve the matter although the locality is now covered by a thick growth of vegetation.

Figured specimen.—UT-TMM 19346, from locality 10 (=TBEG 11-T-35).

Superfamily **LITTORINOIDEA** Gray, 1840, p. 119

Family **LITTORINIDAE** Gray, 1840, p. 119

Subfamily **LITTORININAE** Gray, 1840, p. 119

Genus **LITTORINA** Férussac, 1822, p. xxxiv

Type species.—*Turbo littoreus* Linnaeus, 1758, by subsequent designation (Blainville, 1828, p. 98). Recent in north European seas.

Diagnosis.—Shell smooth or weakly sculptured, usually thick-shelled; aperture inclined to the shell axis, outer lip sharp, upper part produced adaperturally; columella smooth, excavated, flattened, umbilicus covered. Operculum chitinous, nucleus offset from the center.

Remarks.—Most Littorinidae live in the tropics, graze on algae and are primarily intertidal in distribution. The genus ranges from the Pliocene to Recent.

Subgenus **PROSTHENODON** Cossmann, 1888, p. 257

Type species.—*Littorina monodonta* Deshayes, 1865, by monotypy. Eocene of the Paris Basin.

Diagnosis.—Distinguished from *Littorina* s.s. by its more attenuated spire, the spirally striate whorls with deeply impressed sutures, and the prosocline growth lines. Columella broadly flattened and excavated with a strong tooth on the anterior margin, the margin meeting the basal lip in a sharp curve.

Remarks.—The genus is restricted to the Eocene.

Littorina (Prosthenodon) eofasciata, new species
Plate 9, figures 9–10

Description.—Shell small, whorls six, tip and first two flattened, the third with three spiral lirae, the remainder of the spire smooth or with obsolete spiral

lirae, body whorl with stronger lirae and six or seven strong lines on the basal part. Aperture tear-drop shaped, abaxial margin sharply carinate, outer lip (where extant) smooth; columella thick, flattened, margin thinner anteriorly, basal margin strongly bent, approaching a columella plication in character, so forming an oblique tooth-like projection. Color pattern weakly preserved as three darker bands on the spire whorls, one or two more on the body whorl and a tendency for the basal lirae to retain a bluish tinge.

Remarks.—At least 14 species of *Littorina* s.l. have been described from the Paris Basin, the presence of the tooth-like projection is diagnostic of subgenus *Prosthenodon,* a rare taxon known from the Lutetian and doubtfully the Cusian. A comparison of *L. (P.) eofasciata* and *L. (P.) monodonta* shows the latter species is more elongated and has spiral lines over the entire shell; this species also according to Cossmann (1888, p. 257) shows traces of widely spaced but narrow color bands. A similar banded coloration is seen in the type of the genus, *L. littorea.* No littorinid seems to have been reported previously from the Gulf Coast or East Coast Paleogene of the United States. A single species, *Littorina subobesa* Cooper, 1896, has been reported from the Marysville Eocene of California; the holotype, according to Keen and Bentson (1944, p. 168), was probably destroyed in the San Francisco fire of 1906; it was not mentioned by Dickerson (1913), in his faunal report on the Marysville.

Etymology.—Referring to the color banding on this Eocene species.

Type information.—Holotype: PRI 33100, 4.3 mm length; paratype: PRI 33101. Type locality: locality 4.

Material examined.—Three specimens, the largest is damaged, but is estimated to have been 7.9 mm long.

Superfamily **TRUNCATELLOIDEA** Baker, 1956, p 29

Family **VITRINELLIDAE** Bush, 1897, p. 107

Subfamily **VITRINELLINAE** Bush, 1897, p. 107

Genus **CYCLOSTREMISCUS** Pilsbry and Olsson, 1945, p. 266

Type species.—Vitrinella panamensis C. B. Adams, 1852, by original designation. Recent western Panama and Mazatlan.

Diagnosis.—"The shell is small or minute (usually less than 3 mm. in diameter), solid or moderately strong, depressed or discoidal, much wider than high, umbilicate, of few (about three more or less) whorls, of which the first one and one third to two form a smooth nuclear shell. Last whorl typically having several spiral angles or carinae, their intervals typically with lower axial riblets or striae. Aperture subcircular or modified by the angles of the shell, the peristome continuous, not thickened externally" (Pilsbry and Olsson, 1945, p. 266).

Remarks.—The genus is abundantly represented in the tropical seas of the west coast of America. The genus ranges from the Upper Cretaceous to Recent.

Cyclostremiscus axacuus (Conrad, 1833b)
Plate 9, figures 11–12

Solarium axacuum Conrad, 1833b, p. 44.
Delphinula plana I. Lea, 1833, p. 117, pl. 4, fig. 104; H. C. Lea, 1849, p. 99; Harris, 1895c, p. 34.
Solarium exacuum Conrad *in* Morton, 1834, p. 3; Conrad, 1835, p. 48, pl. 17, fig. 5; H. C. Lea, 1849, p. 105; de Gregorio, 1890, p. 135 in part, pl. 12, figs. 33, 34 copy *S. plana* Lea, figs. 35, 36 copies Conrad figs. 37–39; not figs. 40, 41 copy *S. delphinoides* Meyer = *Circulus ottonius* Palmer; Harris, 1895c, p. 19.
Solarium Exacutum [sic] Conrad. d'Orbigny, 1850, p. 348.
Architectonica exacuua (Conrad). Conrad, 1865a, p. 29; 1866a, p. 13.
Achitectonica plana (I. Lea). Conrad, 1865a, p. 30; 1866a, p. 13.
Adaeorbis exacua (Conrad). Dall, 1892, pp. 331, 344, 347.
Adaeorbis exacuus (Conrad). Cossmann, 1893, p. 252.
Tornus (Adaeorbis) exacuus (Conrad). Cossmann, 1918, p. 98.
Circulus exacuus (Conrad). Palmer, 1937, p. 53, as *exacuum,* pl. 5, figs. 28, 34, 37; Brann and Kent, 1960, p. 222; Glibert, 1962a, p. 71.
Cyclostremiscus exacuus (Conrad). Palmer and Brann (1966), p. 618; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, pp. 19, 31.

Original Description.—"Discoid, with revolving acute lines; whorls with a wide indentation at the suture; submargin widely indented, and the periphery acutely carinated; beneath flattened; umbilicus smooth, aperture subovate." (Conrad, 1833a, p. 44)

Remarks.—As Palmer (1937, p. 53–54) noted there are two forms within this species, one with more rounded whorl profile and a greater number of spiral lines than the other. Both forms start with three spiral lines on the first post-nuclear whorl. Palmer and Brann (1966, p. 616) list the species as also occurring in the Cook Mountain Formation of Texas and the McBean Formation of South Carolina. Typical *C. axacuus* is fairly common throughout the marine Claiborne in Texas; a second species is also present that starts its post-nuclear whorls with two strong spiral lines. The Reklaw Formation specimens of *C. axacuus* are within the limits of variation of the species from the Weches and Cook Mountain formations but as a group the Gosport Sand Formation specimens might be separated by their greater size, the wider flat area margining the umbilicus and the imbricate character of the growth lines in the umbilicus. There are, however, Gosport Sand Formation specimens that fit well within the Texas group; the converse has not been observed. Conrad (1833b, pp. 39, 44) named the species *Solarium axacuum* accompanied by a description and used the

same name in his list of species in the contents; Conrad (1835, p. 48, pl. 17) renamed it *Solarium exacuum*. All succeeding authors have treated the 1833 spelling as an error. Unfortunately, according to the ICZN, Art. 32 (c) (ii), it "requires clear evidence of an inadvertent error" to designate an incorrect original spelling; Moore (1962, p. 59) notes *Solarium exacuum* in Conrad's handwriting on the specimen card in the ANSP, but this falls under the "external information" sentence in the same section of the code cited above and so is inadmissible as a reason for change.

Type information.—Lectotype: ANSP 15389. Type locality: Claiborne Bluff, Monroe County, Alabama. Figured Reklaw specimen: PRI 33102, from locality 4.

Material examined.—Ten specimens, the largest: 3.3 mm greatest diameter, 1.0 mm thickness.

Family **SKENIDAE** Clarke, 1851, p. 472

Genus **TUBIOLA** A. Adams. 1863a, p. 74

Type species.—Turbo nivea A. Adams, 1863, by subsequent designation, (Kobelt, 1879, p. 154). Recent, Sea of Japan.

Diagnosis.—"Shell very small to small, similar to *Skena,* moderately high to discoid in shape. Whorls rounded, with spiral lines, body whorl large, sutures deeply impressed. Last whorl large, umbilicus funnel-shaped, columella thickened, aperture circular to oval, entire, set at an angle to the shell axis." (trans. from Wenz 1938, p. 327)

Remarks.—The genus ranges from the Eocene to Recent.

Tubiola gracilis, new species
Plate 9, figures 13–14

Description.—Shell very small, thin-shelled, three and three-quarter whorls. Nucleus small, rounded and flattened. Whorls flattened posteriorly, only very lightly in contact, surface smooth, or with microscopic growth lines. Peristome entire, rounded, posteriorly produced, the edge swinging back below the flattened posterior area. A few stronger lines of growth, thickened threadlike, can be seen behind the aperture. Umbilicus rounded, deep, within with more prominent growth lines.

Remarks.—This species has a remarkably thin shell and that feature is no doubt responsible for the paucity of specimens. The only other species known from the Gulf Coast Paleogene is *Tubiola nautiloides* (Aldrich, 1910b) from the Cook Mountain Formation of Mississippi, distinguished by its smaller umbilicus, a different apertural profile and a body whorl extending free of the previous whorl. Palmer (1937, pl. 21, fig. 10) figures a species, *"Adeorbis" incertus* (de Gregorio, 1890), which is suggestively like *T. gracilis* but the description is not good enough for a meaningful comparison, and the specimen is lost. The generic placement is in some doubt as the type, *T. nivea* has a thickened columella while in the new species that is only marginally so. The very thin shells of *T. gracilis* could imply a pelagic existence for the animal and three possibilities suggest themselves. As the shell is dextrally coiled it is unlikely to be a pteropod and even if these are assumed to be abnormally coiled specimens, no known coiled Eocene pteropod is at all similar in shape or size. Two heteropod families are known from the Eocene of the Paris Basin, the Atlantidae and the Carinariidae. The Atlantidae are planispirally coiled and from the illustrations in van der Spoel (1976) have a swollen nucleus, and initial whorls offset from the shell axis. These are represented by *Eoatlanta,* Cossmann, 1889; a dextrally coiled genus, usually keeled, or with a triangular shaped aperture. The other heteropod family, Carinariidae, might be considered, and one genus in that family, *Cardiapoda* d'Orbigny, 1836, has a similar shell. The shell is typically extremely minute, however, and after a few planispiral whorls the shell is greatly enlarged. The pelagic family Janthinidae are not known in the fossil state; they have an asymmetrical cylindrical protoconch and are not planispiral in form.

Etymology.—The specific name *gracilis* (Latin, thin), refers to that feature of the shell.

Type information.—Holotype: PRI 30316. Type locality: locality 20.

Material examined.—Three specimens, the largest: 2.9 mm maximum diameter, 1.5 mm height 1.5 mm.

Genus **SOLARIORBIS** Conrad, 1865a, p. 30

Type species.—Delphinula depressa I. Lea, 1833, by subsequent designation (Dall, 1892, p. 414). From the Gosport Sand Formation, Eocene of Alabama.

Diagnosis.—Shell small, depressed, moderately thick shelled. Nucleus small but fairly prominent, smooth and shining, paucispiral. Surface smooth or with punctate spiral lines. Aperture holostomous; peristome angulated and slightly sulcate at the commissure. Parietal wash heavy, umbilicus small, partially covered by the thickening of the umbilical carina.

Remarks.—Conrad proposed this genus in a heading for a list of four disparate shells, Dall designated the first as type, the others now being referred to the genera *Solariella* (Wood, 1842), *Norissia* (Bayle, 1880) and *Cirsochilus* (Cossmann, 1888). The genus is restricted to the Tertiary. Modern members of the Vitrinellidae are reported to feed on algae and to be parasitic on worms.

Solariorbis discoides, new species
Plate 9, figures 15–16

Description.—Shell very small, diameter 2 mm, rounded, discoidal. Whorls four, nucleus flattened, spire convex, whorls rapidly expanding. Body whorl flattened above and below, evenly rounded at the edge. Suture impressed and margined below by a narrow depression. Surface smooth and polished, the upper surface smooth or spirally striate, lines of growth microscopic in size only. Aperture round, margin strongly oblique, thickened near the basal callus which is lunate in shape and projects back partially over the umbilicus. Area between the basal margin and thickened region with at least two faint spiral grooves. Umbilicus small, obscurely margined by the thickened callus.

Remarks.—The closest relative seems to be *Solariorbis rotulus* (Heilprin, 1879) from the Gosport Sand Formation, where the sutural region is developed as a wide concavity rather than a groove. When a large suite of specimens is examined it is found that the presence or absence of spiral lines cannot be used as a distinguishing characteristic. Most specimens are dorsally smooth but a continuous graduation does exist to entirely spirally striate examples. One specimen shows an abrupt transition from the smooth stage to the spirally striate stage. Generally, juvenile specimens are free of spiral ornament while one or more lines are developed in the adult. Characters distinguishing *S. discoides* from *S. rotulus* and other more distantly related species are the sharp rim of the callus on the expanded outer lip and the non-punctate character of the spiral lines. Very faint traces of nacre are visible on some specimens, and since these are typical of *Solariorbis* as now understood, they could make the placement of the genus within the Vitrinellidae doubtful.

Etymology.—The specific name *discoides* (Latin, disc shaped), refers to the discoidal shape of the shell.

Type information.—Holotype: PRI 30317; paratypes: PRI 30318, 30319. Type locality: locality 20.

Material examined.—200+ specimens, the largest 2.0 mm width.

Solariorbis conicus, new species
Plate 9, figures 17–18

Description.—Shell very small, solid, three and three-quarter whorls. Nucleus minute and seemingly partially immersed. Whorls smooth, rapidly expanding, early whorls convex, later ones straight to slightly concave, profile of spire approximating that of a low cone. Suture impressed and ragged on later whorls. Body whorl rounded, base flat to concave, umbilicus small and partially obscured by a slight thickening of the basal apertural callus.

Remarks.—This species is readily distinguishable from other *Solariorbis* species by the cone-shaped profile and smooth whorls. No subsutural depression or basal umbilical callus is apparent, although a pronounced color change in many specimens indicates its position. Larger specimens have the later whorls encroaching considerably over the previous ones which in one specimen almost completely envelops the protoconch. This species is restricted to the highest fossiliferous bed at Ridge Creek.

Etymology.—The specific name refers to the conical profile.

Type information.—Holotype: PRI 30320; paratypes: PRI 30321, 30322. Type locality: locality 7.

Material examined.—75 specimens, largest specimen 2.03 mm width.

Solariorbis? parsnaticoides, new species
Plate 9, figures 19–20

Description.—Shell very small, ca. 1 mm diameter, solid, globose. Whorls three and one-half, nucleus partially immersed within the succeeding whorl. Sutures moderately impressed, whorls smooth or showing lines of growth. Spire whorls carinated, flattened above and below the carina. Body whorl rounded-bicarinate, the lower carina more acute, curving smoothly below to the base. Aperture rounded-quadrate thickened from the lower margin to a point a little past the upper suture and expanded into a large tongue where it meets a smooth umbilical rib. Umbilicus wide and defined by a carina at the outer edge and partially covered over by the reflected columella margin.

Remarks.—This is a very difficult species to place, even to the family level. The characters seen in *Solariorbis conicus* n. sp. are accentuated to an even greater degree here. The smooth whorls, high profile and lack of a margining umbilical callus are not typical of *Solariorbis* s.s. although the umbilical cord ending in a planed-off callus lobe is distinctive of that genus. They are unlikely to be juvenile shells with three and one-half whorls, a typical number for many *Solariorbis* species. Pilsbry and McGinty (1945) introduced the subgenus *Diagonaulus* within *Didianema* for a group of small globose vitrinellids with a carinate or strongly angulated umbilicus and these shells are very similar to those in shape. A distinguishing characteristic of *Diagonaulus,* however, is a narrow shelf within the aperture (for probable placement of an operculum) and these specimens lack that feature. *Heniastoma* Cossmann, 1918 might also be considered but species of this subgenus of *Collonia* J.E. Gray, 1850b are depressed and instead of an umbilical cord there is an angulation ending at a moderately flared outer lip. *S. parsnaticoides* has only been found at locality 14,

where the most extreme dwarfing of the fauna is apparent.

Etymology.—The specific name *parsnaticoides* (Latin, Natica-like), refers to the similarity to a *Natica* shape.

Type information.—Holotype: PRI 30323; paratypes: PRI 30324–30326. Type locality: locality 14.

Material examined.—12 specimens, the largest ca. 1.4 mm. width.

Subfamily **TEINOSTOMINAE** Cossmann, 1917, p. 210

Genus **TEINOSTOMA** H. and A. Adams, 1853, p. 122

Type species.—Teinostoma politum A. Adams, 1853, by subsequent designation (Cossmann, 1888, p. 44). Recent from Santa Elena, Ecuador.

Original diagnosis.—Shell orbicular, depressed, subspiral, polished, last whorl rounded at the periphery; umbilical region covered with a large flat callosity; aperture transverse, rounded, greatly produced and elongated, ending anteriorly in a slightly caniculated point; inner lip smooth, callus not emarginate or truncate anteriorly; outer lip thin, simple, not margined or reflected.

Remarks.—The genus rangs from the Upper Jurassic to Recent.

Teinostoma cf. **texanum** Palmer, 1937
Plate 9, figures 21–22

Teinostoma texanum Palmer, 1937, p. 46, pl. 2, figs. 20–22; Brann and Kent, 1960, p. 837; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 11.

Original Description.—"Shell medium, about three and one-half whorls, not enveloped and not elevated; sides of body whorl rounded; umbilicus covered completely with a solid callus; surface smooth." (Palmer, 1937, p. 46)

Remarks.—One juvenile shell was obtained which agrees very well with *T. texanum,* a species described from the Stone City Member of the Sparta Formation.

Type information.—Holotype: PRI 2658. Type locality: Stone City bluff (type), Burleson County, Texas. Figured Reklaw specimen: PRI 33103, from locality 20.

Material examined.—One specimen, 0.5 mm maximum diameter.

Superfamily **STROMBOIDEA** Rafinesque, 1815, p. 19

Family **STROMBIDAE** Rafinesque, 1815, p. 19

Genus **ECTINOCHILUS** Cossmann, 1889, p. 57

Type species.—Strombus canalis Lamarck, 1803, by original designation. Eocene of the Paris Basin.

Diagnosis.—Shell high, tapering, varicose and costate. Whorls convex with longitudinal ribs and fine spiral lines. Aperture anteriorly wide and notched, posteriorly also notched and bordered with callus which extends onto the spire whorls. Outer lip extended and thickened, smooth within; columella broadly concave and smooth.

Remarks.—The genus ranged from the Paleocene to Oligocene and was widely distributed in Eocene times.

Ectinochilus sp.
Plate 14, figure 10

Remarks.—One very small fragment was obtained consisting of three smooth protoconch whorls and two and a half adult whorls. It appears similar to *Ectinochilus texanum* (Harris, 1895a), but with more convex whorls and stronger ribs. This records the presence of this genus in the Reklaw.

Figured specimen.—PRI 30380, from locality 4.

Superfamily **VANIKOROIDEA** Gray, 1840, p. 121[4]

Family **FOSSARIDAE** Troschel, 1861, p. 153

Genus **POSTALIA** Oppenheim, 1896, p. 165–166

Type species.—Postalia postaliensis Oppenheim, 1896, by original designation. Eocene of Monte Postale, northern Italy.

Diagnosis.—Shell medium in size, of two and a half whorls with very deeply impressed sutures, the last whorl comprising almost the entire shell. The first one and a half whorls are similar to an *Adeorbis,* with a globose protoconch that develops stronger spiral sculpture on the last whorl. The last whorl making up the adult shell expands very rapidly, opening out trumpet-like, the aperture in a plane parallel to the axis. The outer lip is simple, the columella thin, vertical and defining one edge of a deep but narrow umbilicus. The ornament consists of narrow spiral ribs, 22 on the last whorl, 12 on the preceding. (Free translation of Oppenheim, 1896, pp. 165–166)

Remarks.—The genus is restricted to the Eocene. Wenz (1940, p. 884) regarded the placement within the Fossaridae as doubtful, but did not suggest an alternative. The genus does not seem to have been commented on since.

Postalia americana, new species
Plate 13, figures 11–14

Description.—Whorls four to four and three-quarters, rounded discoidal, flattened anteriorly and barely or not at all in contact. Nucleus immersed but may possibly be eroded. Protoconch large, rounded, of

[4] *Nomen trans.* Ponder and Warén, 1988.

three volutions and with six to seven spiral lines ending in a rib. The first half whorl of the adult shell is smooth and rounded except for lines of growth, thereafter the whorls develop a sculpture of widely spaced rounded costae of gradually increasing strength, crossed by lines of growth giving the surface a rough muricate appearance. The protoconch and first one and a half adult whorls are at an acute angle of about 30° to the shell axis. Outer lip thin, trapezoidal in shape, the lower margin widely flaring and comarginal with the external costae. Base of body whorl with stronger ornament than the upper surface and with a wide umbilicus.

Remarks.—These specimens might be regarded as abnormalities, particularly in regard to the change of shell axis but all three specimens show the same feature. The only other species in this genus is the type from Northern Italy. As Oppenheim (1896) notes, the systematic placement is problematical, perhaps as that author surmises the shape of the shell is connected with some form of parasitism on crinoids. A somewhat similar recent American species is *Cyclothyca corrugata* Sterns, 1890, questionably from the west coast of Nicaragua; only one specimen has been discovered.

Etymology.—Noting the first occurrence of the genus in the New World.

Type information.—Holotype: PRI 30369; paratype: PRI 30370. Type locality: locality 20.

Material examined.—Three specimens, the largest (with some flattening on the body whorl) 15.0 mm width, 8.0 mm length.

Superfamily **VERMETOIDEA** Rafinesque, 1815, p. 144[5]

Family **VERMETIDAE** Rafinesque, 1815, p. 144

Genus **SERPULORBIS** Sassi, 1827, p. 482

Type species.—Serpulorbis polyphragma Sassi, 1827, by original designation. Tertiary of northern Italy.

Diagnosis.—Tubes either free or attached, irregularly wound, often a flat spiral. Adult sculpture of three or more rough nodose longitudinal costae, broken feeding tubes often present on larger specimens.

Remarks.—Recent representatives of the genus are mucus feeders, entrapping floating food particles and pulling them back at intervals. The Vermetidae are difficult to classify, having in the past been confused even up to phylum level. They may be distinguished from annelid worms by the three-layered shell, the inner surface glassy. *Lemintina* Risso, 1826, often cited instead of *Serpulorbis*, is a *nomen nudum* having being described from an annelid. In the absence of nuclear whorls the assignment of the following species follows general usage by other authors. The genus is known from the Upper Cretaceous to Recent.

[5] *Nomen transl.* Pchelintsev and Korobkov, 1960.

Serpulorbis multiclavus, new species
Plate 11, figures 16–17

Description.—Shell attached, colonial, irregular in growth direction. No protoconch observed, juvenile shell with concentric rounded costae and somewhat triangular in crossection. The free apex becomes progressively ridged and more spinose, with increasing age other ridges develop and finally the entire set of longitudinal ridges develops a series of sharp irregularly spaced spines. The internal profile remains circular at all stages of growth. The rounded concentric costae and spines are often hollow and develop holes which do not continue through to the interior of the shell.

Remarks.—There seem to be no close analogs to this species in the Claibornian. *Tenagogus (Agathires) texanus* Palmer, 1937 from the Cook Mountain Formation, might superficially be taken to be this species due to some similarity in external sculpture, but in that species the holes occur in linear rows, continue through to the interior of the tube, and correspond to the external slit band seen in *Tenagogus s.s.* Adult fragments of sculpture are very irregular in character, the concentric costae become irregular swellings, often merge with one another, and develop secondary irregular patterns.

Etymology.–The name notes the multiple ornamented stripes on the tubes.

Type information.—Syntypes: PRI 30345–30349. Type locality: locality 4.

Material examined.—At least 60 fragments of tubes and colonial masses.

Superfamily **CYPRAEOIDEA** Rafinesque, 1815, p. 146

Family **OVULIDAE** Fleming, 1828, p. 331

Subfamily **OVULINAE** Fleming, 1828, p.331

Genus **NEOSIMNIA** Fisher, 1884, p. 664

Type species.—Ovula sepelta Linnaeus, 1758, by monotypy. Recent in the Mediterranean.

Diagnosis.—Shell small to medium sized, elongate, medially inflated, sometimes with an obliquely carinated columella. Dorsum smooth, or more usually spirally striated; anterior and posterior ends spirally striated. Aperture wider anteriorly, columella with an oblique callus plication. Outer lip flattened, smooth or finely toothed, bent anteriorly. Inner dentition rarely developed. Terminal ridge weak or absent.

Remarks.—Modern species are most abundant in warm seas and feed primarily on gorgoniae and corals. The genus ranges from the Eocene to Recent.

Neosimnia scobina, new species
Plate 13, figures 9–10

Description.—Shell small, elongate, outer lip almost straight medially, attenuate at both ends, maximum diameter of base at about one-quarter of the length from the posterior end. Shell smooth medially, excepting at both ends, where under a microscope a few very faint, close together, spiral lines may be seen. Outer lip with about 46 small similarly-sized small teeth. Inner lip with about 33 small teeth gradually decreasing in size posteriorly, disappearing just above the point of maximum inflation, the two terminal teeth slightly more elongate and oblique. A small smooth fossula just visible. Posterior end of the inner lip with a thick pad of callus which is the terminal end of an oblique columella fold.

Remarks.—Two specimens were found, both somewhat crushed, and showing signs of abrasion. The dentate aperture, straight central part of the outer lip and a posterior callus pad is also seen in *Transovula (Oxycypraea) naviculae* Palmer, 1937, which is one of three Eocene Claibornian species Palmer and Brann, 1966, assign to this taxon. Luc Dolin (pers. comm.) places *T. (O.) naviculae* in *Prosimnia* Schilder, 1927. Palmer's species is not as elongate and possesses 25 fine teeth on the outer lip and a lirate inner lip with about 20 strong teeth; in addition the callus pad is not of the same character as *N. scobina,* being terminated abruptly within the aperture, there forming a sharp adapical ridge. *Transovula* de Gregorio, 1880 is usually medium to large in size, dentate on the outer lip, and usually also on the inner lip, the end tooth composed of one to two small folds. *Prosimnia* is small, cylindrically striated, and carinated to some degree above the center, a shape and sculpture quite unlike that of the Reklaw species. The Reklaw specimens are similar to *Neosimnia texana* (Johnson, 1899), although the latter is a more attenuated species, has weaker dentition and three or four grooves at the posterior end instead of the callus pad. The dentition of *N. texana* is probably a variable character; specimens in the author's collection range from weakly dentate to non-dentate. Another dentate species, *Neosimnia regularoides* (Aldrich, 1921), is found in the Lower Eocene at Bells Landing, Alabama. This species is more evenly rounded, and has a narrower aperture and fine revolving lines on the posterior half of the shell. Unfortunately the holotype was broken after figuring, but the fragments still show the details necessary for assignment.

Etymology.—Referring to the fine rasp-like teeth.

Type information.—Holotype: PRI 30379; paratype: PRI 30292. Type locality: locality 4.

Material examined.—Two specimens, the largest (the holotype): 13.5 mm length.

Family **CYPRAEIDAE** Rafinesque, 1815, p. 146

Subfamily **CYPRAEORBINAE** Schilder 1927, p. 97

Genus **CYPRAEORBIS** Conrad, 1865a, p. 31

Type species.—*Cypraeorbis lineata* Conrad, 1848a, by monotypy. Oligocene, Byram Formation of Mississippi, United States.

Diagnosis.—Shell oval to pyriform, aperture posteriorly expanded. Back usually smooth and with one or more brown spots. Both ends sometimes caniculate and appearing notched in the dorsal view. Columellar teeth set back from the margin, end tooth deeply set and forming an elongate weak terminal ridge.

Remarks.—The genus ranges from the Upper Cretaceous to Recent.

Cypraeaorbis bulbus, new species
Plate 13, figures 5–6

Description.—Shell medium in size, prominently pyriform and inflated, acuminate anteriorly. Rear smooth and showing the faint outline of a large dark oval spot. Aperture sinuous, large and flaring anteriorly. Outer lip thickened, constricted in the lower third, and bearing 25–27 fine elongate teeth, columellar teeth 22–25 in number, the last three at a progressively more acute angle to the shell axis, terminal ridge thin, fossula flat to rounded, the inner teeth continuing over the posterior two-thirds. The anterior edge of the aperture sharply ridged, the columella side almost straight and weakly reflected.

Remarks.—In general Cypraeidae are very uncommon within the Eocene of the coastal plain although it has been my experience that within a few very restricted areas they are far less so. The Reklaw species is closest to two Jackson Eocene species: *Cypraeorbis towncreekensis* (Dockery, 1977), and *Cypraeorbis ventripotens* (Cossmann, 1903) than to any Claibornian species, and can be separated by the constriction of the outer lip, the smooth dorsal surface, the greater inflation, and the obtuse angle of the anterior notch. All specimens of *C. bulbus* were found embedded in a large mass of water-worn coral fragments of the Madreporitidae family, which strongly suggests that these Eocene Cypraeidae had association with corals similar to that of modern representatives of the family. The two complete specimens share the shallow de-

pression on the outer lip, one third of the distance from the anterior end, a feature that is not present on another five fragments of outer lips; it is possible that two species are present, but this cannot be confirmed with the present material at hand. The large colored spot seen in many modern representatives of this family is also seen as a darker area on the fossil specimens.

Etymology.—Referring to the prominent bulb-like shape of this species.

Type information.—Holotype: PRI 30371; paratype: PRI 30372. Type locality: locality 21.

Material examined.—Eight specimens (two complete), the largest (the holotype): 32 mm length, 23 mm maximum diameter.

Superfamily **NATICOIDEA** Forbes, 1838, p. 29[6]

Family **NATICIDAE** Forbes, 1838, p. 29

Subfamily **AMPULLOSPIRINAE** Cox, 1930, p. 170

Genus **AMAURELLINA** Fisher, 1885, p. 776

Type species.—*Ampullaria spirata* Lamarck, 1804, by monotypy. Eocene of France.

Diagnosis.—"Shell small to medium sized, moderately elongate, spire elevated, shoulder narrowly channeled, umbilicus narrowly to moderately open, umbilical callus absent, inner lip reflected. A slender cord arises on the thickened anterior inner lip and enters the umbilicus. Shell smooth or with fine spiral ornament." (Marincovich, 1977, p. 241)

Remarks.—The genus is reported from the Lower Cretaceous to the Oligocene. According to Marincovich (1977), the ampullospirids are amongst the earliest known naticids and probably ancestral to the other naticid groups. Modern representatives of the family are primarily Arctic or boreal in deep water.

Amaurellina plummeri, new species
Plate 12, figures 10–11

Description.—Shell small to medium in size, spire elevated, whorls six and a half, rounded below and with a subsutural shelf. Suture deeply impressed, channeled on later whorls. Surface covered with minutely punctate, fine spiral lines, the lines coarser and more crowded subsuturally. Occasional weaker intermediate striae also occur, more prominently on the base. Lines of growth not visible except as color changes in the shell. Anterior lip thickened below the umbilicus, umbilical cord small and flattened. Wide and shallow anterior spout present, peristome continuous.

Remarks.—Three species of *Amaurellina* have previously been reported from the Eocene of North America: *Amaurellina singleyi* (Harris, 1895a), from the lower Claiborne of Lee County, Texas, *Amaurellina caleocia* Vokes, 1939, from the Domengine Formation of California, and *Amaurellina* sp. Richards, 1950, from Wake County, North Carolina. The Claiborne species from Lee County is lost, *fide* Palmer and Brann (1966). The present species can be distinguished from the preceding by the proportionately slimmer outline and more evenly rounded whorls.

Etymology.—In honor of F. B. Plummer who collected the Texas Memorial Museum specimens.

Type information.—Holotype: UT-TMM 3583; paratype: UT-TMM 3582. Type locality: locality 10.

Material examined.—44 specimens, the largest (the holotype), 12.0 mm in height.

Subfamily **NATICINAE** Forbes, 1838, p. 29[7]

Genus **NATICA** Scopoli, 1777, p. 392

Type species.—*Nerita vitellus* Linnaeus, 1758, by subsequent designation (Anton, 1839, p. 31). Recent in the Indo-Pacific.

Diagnosis.—Shell small to medium sized, globose, with a low to moderately elevated spire. Surface generally smooth. Usually umbilicate, with a funicle and umbilical callus; aperture holostomatous, semicircular or ovate; outer lip sharp.

Remarks.—The Naticas are active carnivores preying on other bivalves, gastropods and scaphopods. The range of the genus is Paleocene to Recent.

Subgenus **NATICARIUS** Duméril, 1806, p. 64

Type species.—*Nerita canrena* Linnaeus, 1758, by monotypy. Recent in the West Indies and southeastern United States.

Diagnosis.—"Shell small to medium in size, globose to somewhat elongate, body whorl distinctly inflated. Axial sculpture of sharply incised grooves that extend from suture part way to periphery. Umbilicus usually narrow, rarely broad, with moderately to deeply excavated sulcus. Umbilical callus slender; funicle ranges from robust, to low and indistinct. Parietal callus thin to slightly thickened. Operculum with one or two ribs at outer margin or several ribs over outer portion." (Marincovich, 1977, pp. 371–372)

Remarks.—The subgenus is known from the Eocene to Recent.

Natica (Naticarius) brevisulcata, new species
Plate 12, figures 12–14

Description.—Shell medium sized, of five and three-quarter whorls, nucleus minute and flattened. Su-

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[6] *Nomen transl.* Thiele, 1929, p. 259 (*ex* Naticidae, Forbes, 1838).

[7] *Nomen transl.* Wenz, W., 1941, p. 1039 (*ex* Naticidae Forbes, 1838, p. 29).

ture deeply impressed, channeled, and with short to obsolete radiating sulci that continue as striae over the entire surface of the body whorl. Whorls flattened below the suture, margined by a few striae in the adult, below that regularly rounded. Aperture semilunate, outer lip sharp, columella thin, straight and at an angle of about 20° to the shell axis. Base slightly produced, columella feebly reflected over the posterior end of the umbilicus. Basal margin of the umbilicus strongly carinated in the adult, obscurely so in juvenile specimens. Umbilical interior coarsely spirally striate, slightly convex in the middle where the spiral striae are more prominent.

Remarks.—This species combines may of the features of *"Natica" gilberti* Palmer from the Lower Eocene Hatchetigbee Formation, 1937 and *Natica (Tella) magnoumbilicata* (I. Lea, 1833) from the Gosport Sand Formation. It agrees with *"N." (N.) gilberti* in general shape, character of the suture, and the striated interior of the umbilicus. The radiating striae below the suture and callus reflected over the umbilicus is characteristic of *N. (N.) magnoumbilicata.* These radiating sulci vary greatly in strength but in general decrease in prominence with age. Juvenile specimens of *"Natica" "(Naticarius)" semilunata* I. Lea, 1833 from the middle Claiborne may be superficially confused with *N. (N.) brevisulcata* but the lack of the umbilical rib in the latter will distinguish them. As Harris (1899, p.86–87) noted, some Sabine specimens of *"N." (N.) semilunata* lack the umbilical rib; this form is higher-spired, lacks the radiating sulci and the striae below the suture. Young individuals of these species however, can be very difficult to distinguish from one another.

Etymology.—The specific name is derived from *brevi*—(Latin, short), *sulcata* (Latin, folds).

Type information.—Holotype: PRI 30354; paratypes: PRI 30355, 30356. Type locality: locality 20.

Material examined.—45 specimens, the largest: 10 mm width, 10.5 mm in length.

Subgenus **CARINACCA** Marwick, 1924, p. 553

Type species.—Ampullina waihaoensis Suter, 1917, by original designation. Eocene of New Zealand.

Original diagnosis.–"Shell of moderate size, ovate, smooth, widely umbilicated; spire low; suture sometimes impressed but generally tangential; aperture semilunar; outer lip practically straight but strongly retracted to suture; inclined 25° to 30° from vertical; inner margin straight with a short, fairly thick parietal callus; umbilicus with an obsolete funicle on its long apertural margin (sometimes absent altogether), and bounded by a broad strong ridge formed by a prominent thickening of apertural margin at anterior corner." (Marwick, 1924, p. 553)

Remarks.—The subgenus is restricted to the Eocene.

Natica (Carinacca) moffitti, new species
Plate 12, figures 15–16

Description.—Shell small to medium in size, elongate-ovate. Whorls five, nucleus minute, protoconch of one-half whorl, more or less depressed. Whorls with deeply impressed and slightly channeled sutures, shoulder small, flat, and more visible in the earlier whorls. Surface smooth and polished with prosocline lines of growth and microscopic impressed irregular spiral lines most visible posteriorly; one larger line below the suture. Aperture oblique, semilunate, outer lip thick and anteriorly extended, the lip thickened and reflected forming a wide, sharply defined band that spirals into the umbilicus from the left hand margin. Inner lip straight to slightly excavated with a moderately thick deposit of callus, posteriorly margined by a weak channel. Umbilicus striated within and with a wide weak funicle in the posterior area, the end of which is covered over by a tongue of callus.

Remarks.—The combination of characters seen in these specimens makes them difficult to place generically within the Gulf Coast Tertiary. They most closely resemble *Natica (Naticarius) reversa* Whitfield, 1865 from the Naheola Formation of the Midway Group. That species, which is a higher-spired form, has an umbilicus covered more at the upper margin but does, however, possess a similar, although less sharply defined umbilical band and a weak funicle. At first sight the umbilical band and shouldered whorls might place it in *Ampullina s.s.* of the subfamily Globulariinae, but the presence of the funicle precludes that. The robust nature of the shell, flattened apex, apertural shape and funicle place it in the Naticinae, and with some hesitation it is placed in the subgenus *Carinacca,* so far restricted to the Eocene of New Zealand and one representative *Natica (Carinacca) rasensis* M. A. Hanna, 1927, from the Middle Eocene of California, La Jolla Group, Rosa Cañyon, San Diego. Another similar, although more distantly related species is *Euspira marylandica* (Conrad, 1865a) from the Paleocene Aquia Formation and a variety from the Lower Eocene Tuscahoma Formation; this species possesses a small, weak funicle and shows the incipient development of a reflected outer lip.

Etymology.—The species is named after John Moffitt, geophysicist and trilobite expert.

Type information.—Holotype: PRI 30357; paratypes: PRI 30358, 30359. Type locality: locality 20.

Material examined.—108 specimens, the largest 10.6 mm in width, 11.0 mm in length.

Subfamily **POLINICINAE** Gray, 1847, p. 149[8]

Genus **POLINICES** Montfort, 1810, pp. 223–224, pl. 56

Type species.—Polinices albus Montfort, 1810, by original designation. Recent in the West Indies.

Diagnosis.—Shell small to large, globose to ovate, whorls inflated to flattened, smooth except for incremental growth lines and microscopic spiral costellae; suture slightly to deeply impressed. Umbilicus narrowly to broadly open, funicle weak to absent; umbilical callus slender and broad to massive; parietal callus thin or thick.

Remarks.—Polinices ranges from the Upper Cretaceous to Recent.

Subgenus **PLICONACCA** Cossmann and Martin, 1914, p. 171

Type species.—Polinices trisulcata Martin, 1914, by monotypy. Eocene of Java.

Diagnosis.—Shell ovate, low-spired. Protoconch with one and a half smooth moderately convex whorls; suture impressed, initially with short radiating folds which become obsolete on later whorls and exist there only as growth lines. Whorls convex or with a very slight subsutural depression. Aperture ovate, labrum thickened, no fold, umbilicus partially covered with a thick spread of callus upon which are three impressed grooves, the middle one the strongest, the anterior one also strong and the posterior usually indistinct (after Martin, 1914).

Remarks.—According to Wenz (1941, p. 1031) subgenus *Pliconacca* is restricted to the Eocene.

Polinices (Pliconacca) onustus reklawensis, new subspecies

Description.—Shell medium in size, obliquely ovate in profile. Whorls four and a half to five, nucleus minute, no visible demarcation between the protoconch and adult whorls. Suture finely impressed (more so in earlier whorls) by a line that is just visible under the microscope. Whorls shouldered, concave above and uniformly convex below. Aperture lunate, oblique, outer lip rounded. Inner lip covered with a thick callus covering most of the umbilicus and leaving just a slit. Surface of callus with one transverse groove ending at the upper entrance of the umbilicus and an obsolete parallel depression on either side of it. Umbilicus smooth within, or only showing lines of growth; rounded funicle present and covered with callus to its lower end.

Remarks.—The species is placed in *Polinices* by the character of the callus, the flatsided whorls, and the shape and inclination of the aperture. Incipient secondary callus grooves are sometimes visible, and the three grooves place it in section *Pliconacca,* although with some hesitation due to their obsolete nature. The species has strong affinities with both *Polinices (Pliconacca) onustus* (Whitfield, 1865) of the Midway group, and the higher spired form *P. (P.) onustus* in the Sabine; it would seem *P. (P.) onustus reklawensis* is the continuation of that line in the Reklaw which leads to *Polinices aratus* (Gabb, 1860) of the middle Claibornian. The species, however, is decidedly nearer *P. (P.) onustus,* to which it is referred as a subspecies.

Etymology.—Referring to the Reklaw Formation.

Type information.—Holotype: PRI 30360; paratypes: PRI 30361, 30362. Type locality: locality 20.

Material examined.—87 specimens, the largest 13.5 mm in length, 11.2 mm in width.

Subfamily **SININAE** Woodring, 1928, p. 387

Genus **SINUM** Roeding, 1798, p. 14

Type species.—Helix haliotoidea Linnaeus, 1758, by subsequent designation (Dall, 1915, p. 109). Recent off the coast of West Africa.

Diagnosis.—Shells small to large; whorls typically depressed, may be globose, rarely elongate; sculpture with distinct, closely spaced costellae. Umbilicus extremely narrow and slit-like or closed. Outer lip may be weakly crenulated.

Remarks.—Sinum is known from the Upper Cretaceous. It is primarily tropical in distribution.

Sinum taylori, new species
Plate 13, figures 3–4

Description.—Protoconch of two and a half to two and three-quarter smooth, erect whorls. Adult sculpture starts at an oblique angle, the line defining the transition being practically tangential to the suture of the preceding whorl. Sculpture of numerous longitudinal spiral flat-topped striae and wide interstices and sometimes one to two microscopic intermediate threads. Collabral sculpture of microscopic but distinct rounded spiral threads, sometimes crowded, the threads overriding the longitidinal striae, the two sets together forming a reticulated pattern. Aperture ovate, callus thin and reflected over the upper part of the umbilicus.

Remarks.—On the basis of the degree of flattening of the shell, the Eocene species of *Sinum* from the Gulf coastal plain can be arranged in the following sequence: *S. fiski* LeBlank, 1942, *S. bilix* (Conrad, 1833c), *S. declive* (Conrad, 1833b), and *S. arctatum* (Conrad, 1833b); *S. fiski* is from the Wilcox Group,

[8] *Nomen transl.* Kabat, 1991 (*ex* Finlay and Marwick, 1937, p. 53).

the other three range from the Middle to the Upper Claiborne Within the above sequence both *Sinum taylori* and *Sinum moveum* (described next) would be placed between *S. declive* and *S. arctatum,* being however closer to *S. declive.* The sculpture of *S. taylori* is quite distinct, with its sharp raised lines and almost no intermediate striae in the interstices, *S. declive* has that arrangement almost reversed in having fine impressed lines and many intermediate striae. Both Reklaw species are additionally characterized by the near tangential transitional line separating the juvenile from adult shell. A similar pattern of sharp raised lines is also seen in *S. arctatum.*

Etymology.—Referring to the type locality, Joe Taylor Branch.

Type information.—Holotype: PRI 30363; paratypes: PRI 30364–30366. Type locality: locality 20.

Material examined.—18 specimens, the largest 6.7 mm length, 7.0 mm height.

Sinum moveum, new species
Plate 13, figures 1–2

Description.—Shell elongate, oval, protoconch of three smooth erect rounded whorls, nucleus minute. Last protoconch whorl and first quarter adult whorl slightly depressed within the final body whorl. Suture deeply impressed. Adult stage of one and a quarter to one and a half whorls, surface granular, sculpture of close-set spiral striae and finer intermediate threads that appear wrinkled due to periodic lateral offsets at larger lines of growth. The effect is that the shell appears to possess curved longitudinal striations when viewed from some distance. Aperture obliquely ovate with a callus reflected and covering the right hand edge of the large ovate umbilicus.

Remarks.—Very similar in shape to *Sinum declive* (Conrad, 1833b) although the sculpture in that species consists of broader bands and the umbilicus is sublunate. From the shape alone *S. moveum* is additionally distinguished by possessing a broad shoulder carination, and another anterior to that on the body whorl. The juvenile to adult transition is intermediate in form to that in *S. declive* and *S. taylori.*

Etymology.—The name *moveum* (Latin, movement), refers to the wavy character of the spiral striae.

Type information.—Holotype: PRI 30367; paratype: PRI 30368. Type locality: locality 20.

Material examined.—19 specimens, the largest uncrushed specimen, 8.2 mm width, 8.1 mm height.

Superfamily **TONNOIDEA** Suter, 1913, p. 313

Family **CASSIDAE** Swainson, 1840, p. 89

Genus **GALEODEA** Link, 1806, p. 113

Type species.—*Buccinum echinophorum* Linnaeus, 1758, by monotypy. Recent in the Atlantic and Mediterranean.

Diagnosis.—Shell thin, with a moderately elevated spire, appressed suture and uniform spiral sculpture; sometimes more or less nodulous on the prominent spiral keels; with a conspicuous periostracum; the outer lip reflected and more or less transversely lirate, with a tendency to a more prominent denticle near the posterior angle and at the proximal end of the canal; inner lip with a broad callus, smooth or obscurely lirate, with margin more or less free in the adult; canal elongate and recurved, with just a trace of a siphonal fasciole; operculum subovate with the nucleus eccentric.

Remarks.—*Galeodea* is known from the Eocene onwards, recent in the Mediterranean.

Subgenus **MAMBRINA** Gardner, 1939, p. 23

Type species.—Type species.—*Cassidaria planotecta,* Meyer and Aldrich, 1886, by original designation. Cook Mountain Formation of Newton, Mississippi.

Diagnosis.—Shell medium in size to large. Protoconch naticoid, early whorls offset from the vertical axis by about 15°. Spire flat to moderately coleoconoidal, later whorls often encroaching over the earlier ones. Body whorl bicarinate, "box-like", the area between the carinae flat to concave, the carinae outlined by noded spirals, the remaining spiral sculpture usually fine and simple, only one varix and that a terminal one. Outer lip thickened, with a strong tooth anteriorly, and usually dentate along its entire length. Callus shield broad, flaring, detached below the lower keel; anterior canal, long, slender, produced in the plane of the aperture, but not in the axis of body and spire.

Remarks.—There is some confusion regarding the subgenera *Mambrina* and *Gomphopages,* Gardner designated *Cassidaria planotecta* Meyer and Aldrich, 1886 as type of *Mambrina* and included three species in the subgenus: *G. (M.) koureos* Gardner, 1939, *G. (M.)* sp. from the Wilcox Group of Mexico, and the type *G. (M.) planotecta* (Meyer and Aldrich, 1886). In the same publication she also defined subgenus *Gomphopages* with *Galeodea (G?) millsapsi* Sullivan and Gardner as the type. She first states the subgenus is only known from the holotype, but then on the next page questionably includes *G. (G?) millsapsi* in the same taxon. Three primary characters are used to characterize *Gomphopages*: the heavy chalky textured shell, the long slender anterior canal, and the prominent shoulder tubercles that are flattened in the plane of the axis and connected by low axial riblets to the basal series of nodes. On examination of the holotype it only appears as if the shell has a chalky texture, the texture probably due to weathering and damage during preparation; the shell was encased in a hard matrix and shows indications of having been badly prepared with

hammer and chisel. The long anterior canal, and flattened shoulder tubercles are features of both the *Mambrina* and *Gomphopages* sections and so cannot be used in separation of the two. Specimens that can be assigned to *G. turneri* from the Weches Formation near Nacogdoches show a variable development of the axial riblets, some possess them weakly and others not at all. On balance then, the only consistent feature separating *Gomphopages* from *Mambrina* is the heavy shell and that also appears to be dependent on age, older larger specimens are generally heavier shelled. I believe, therefore, that *Gomphopages* is a synonym of *Mambrina, Mambrina* having page priority in Gardner's publication. Unfortunately Gardner's assignment of *G. koureos,* followed by MacNeil in MacNeil and Dockery, 1984, and the similar species from Mexico to *Mambrina,* is also in error. *G. koureos* and *Galeodea dubia* (Aldrich, 1885), which ranges from the Hatchetigbee Formation to the Weches Formation, clearly form a separate group which is characterized by a rounded body whorl with two to four spiral rows of nodes; a higher, often stepped spire; shows no sign of a long anterior canal; and often possesses more than one varix. Over 60 specimens of *G. dubia* were examined from the Weches Formation and not one showed any indication of a long anterior canal. Two Eocene European species which also appear to belong to this latter group are *Galeodea coronata* (Deshayes, 1830) and *"Cassis" striata* J. Sowerby, 1812. As noted by Palmer (1937, p. 253), G. D. Harris identified specimens of the Sabine species *Galeodea dubia* (Aldrich, 1885) from the Weches of Burleson Bluff, a range that would include the Reklaw era. I have verified the occurrence at Burleson Bluff and the same or a very similar species is common in Weches strata near Nacogdoches; no example of this species or anything similar has been discovered in the Reklaw deposits and in any case this species has little similarity to the ones discussed above.

Galeodea (Mambrina) turneri Gardner, 1939
Plate 14, figures 6–7

Galeodea (Gomphopages) turneri Gardner, 1939, p. 25, pl. 8, figs. 1, 4.

Original description.—"Shell of usual dimensions for the group, unusually heavy. Spire very low, the apex scarcely rising above the reverted lip at the posterior extremity of the aperture. Body whorl widely shouldered, deeply serrate at the periphery and serrate but less deeply at the second carina which outlines the base of the body. Inner lateral margin deeply and sharply constricted at the base of the body, the outer margin scarcely at all. Anterior canal horizontally compressed and turned sharply to the left and backward. A single nuclear whorl preserved. Four rapidly enlarging postnuclear whorls, the incised suture following the periphery and on the last whorl crenulated by the coronal spines. Entire surface spirally lirate, the lirae tending to alternate in strength and running about five primaries to each of the whorls of the spire and the shoulder of the body, finer and less regular upon the medial portion of the body, coarser toward the anterior fasciole. Axial sculpture developed only upon the final whorls. Peripheral spines very strong, laterally compressed, nine on the unique type, one of the nine partly concealed by the reverted outer lip; series at the base of the body less prominent, more conical than those on the periphery but in line with them. Incremental sculpture relatively strong, retractive upon the shoulder. Aperture narrow, obliquely lenticular, bent towards the apex and obtusely angulated posteriorly, obscurely angulated also at the periphery, compressed anteriorly into a slot-like opening. Apertural opening entirely surrounded by heavily callused margins. Outer lip very much thickened and reverted, with a suggestion of a *Cassis*-like flattening and, at the opening to the anterior canal, a suggestion of a constriction such as that upon *Strombus* for the extrusion of the eye stalks; reverted lip continuous around the posterior commissure, encroaching slightly on the preceding whorl and spread widely and heavily over the body whorl, but free from it between the base of the body and the anterior fasciole. Fasciole conspicuously wide and conspicuously compressed, oblique to the axis of the shell. Dimensions of holotype: Height, 43.0 millimetres; greatest diameter, 38.0 millimetres; diameter at right angles to the greatest diameter, 32.0 millimetres." (Gardner, 1939, p. 25)

Remarks.—Gardner's description of this species is very good but as she only had one worn specimen some additional remarks can be made. The protoconch is large and consists of three smooth rounded whorls; the nucleus is expanded and flattened; the protoconch and first half teleoconch whorl are offset by an angle of about 15° from the shell axis. Teleoconch whorls start with eight or nine spiral lines that after the first half whorl become crenulated; suture margined by a slightly concave ramp, the ramp delimited by two slightly stronger crenulated lines, the upper duplex, and a weaker medial one. The type has nine peripheral flattened spines but the number varies between seven and 12 with nine the most common number on large specimens. The very fine Reklaw specimen figured has a beautifully polished, almost glazed surface, the body whorl with effervescent spiral sculpture and prominent growth lines. Larger specimens often show irregular labial rugae which with increasing age migrate from

within the aperture and thus become visible. Juvenile specimens of *G. (G.) turneri* are very difficult to distinguish from juvenile specimens of the cassid *Phalium (Semicassis) reklawensis* n.sp., their separation will be discussed further under that latter species' section. The number of large complete and fragmentary specimens of *G.* (G.) *turneri* shows this to have been one of the commonest large gastropods in the Reklaw seas; it is surprising only one specimen of this impressive species has previously been discovered.

Type information.—Holotype: USNM 495184. Type locality: USGS Sta. 13808, bend of Colorado River, 4.8 km (=3 miles) above old Burleson ferry. The exact location has been lost but from the description it appears to also be locality 8 (TBEG 11-T-72) which is in the Reklaw Formation, and not the Weches as given by Gardner. Figured Reklaw specimen from location 14.

Material examined.—The type, an additional six relatively complete individuals and 15 partial specimens. The largest, PRI 33125, that is figured is 63.5 mm length, 31.8 mm maximum diameter.

Genus **PHALIUM** Link, 1806, p. 112

Type species.—Buccinum glauca Linnaeus, 1758, by subsequent designation (Dall, 1909b, p. 62). Recent in the Indo-Pacific.

Diagnosis.—Shell medium in size; spire acuminate; last whorl well-rounded. Both the false and true umbilicus usually open. Parietal shield anteriorly well-developed; outer lip thick and with one row of denticles which may be produced into spines at the lower end.

Range.—The Cassidae are known from the Eocene onwards, and are carnivorous. Their main prey is reported to be sea urchins. The group is found predominantly in warmer waters although a few live in cooler latitudes.

Subgenus **SEMICASSIS** Mörch, 1852, p. 112

Type species.—Cassis bisulcata Schubert and Wagner, 1829, by subsequent designation (Harris, G. F., 1897, p. 198). East Africa to the Marshall Islands and Japan to Australia.

Diagnosis.—Shells somewhat globular, rarely with varices on the spire; outer surface usually with numerous spiral threads or incised lines. Columella shield finely wrinkled. Outer lip with fine denticles; base of outer lip smooth. Siphonal fasciole is rounded, showing a few longitudinal lines adaperturally.

Phalium (Semicassis) reklawensis, new species
Plate 13, figures 7–8

Description.—Shell small to medium sized, protoconch of three and a half smooth globular whorls, the first minute and flattened. Adult sculpture begins sharply with six to nine spiral revolving lines and equal sized longitudinal ribs that become obsolete after one whorl. Spire whorls shouldered, with one large spiral line on the carina and another large one below. In older specimens the ribs on and below the carina develop many small pointed nodes.The interstitial area between the spiral lines usually with one to three, sometimes many interstitial threads. Over the later whorls the sculpture consists of thick revolving ribs, rarely with smaller lines, the interstitial spaces with spiral threads; the whole crossed by numerous close-set striae, the intersections of the two being slightly nodular. Outer lip prominently thickened, the edge sharp, and with 11 to 12 small linear teeth and one larger one underneath the suture at the posterior end. Columellar shield with large wrinkles, regular above, irregular below and within the lower portion of the aperture. Small umbilicus present but covered by the columellar shield. Siphonal fasciole longitudinally threaded. Larger specimens have the body whorl slightly bicarinate, the lower carina defined by a thickened, sometimes nodular line.

Remarks.—Over 40 complete juvenile and near-adult specimens show this to be a relatively common species in the Reklaw. One large fragment indicates the species reached perhaps 30 mm in length, indicating that all complete specimens may be to some extent juvenile. The early whorls of this species are quite difficult to separate from *Galeodea (Gomphopages) turneri* Gardner, 1939; without the protoconch one could note *G. (S.) reklawensis* has spiral lines of differing strengths, sharper longitudinal ribbing, and beading at their intersections with the spiral sculpture. A specimen from St. Maurice, Louisiana in the Academy of Natural Sciences in Philadelphia labelled *Galeodea planotecta* (missing the outer lip) has similar but not quite so coarse an ornamentation and no longitudinal ribbing on the spire. Large fragments of the body whorl of this species show mature individuals becoming bicarinate, and then tricarinate in shape. The absence of varices on the spire, the wrinkled columellar shield and the longitudinally threaded siphonal fasciole place the species in *Semicassis*. The earliest *Semicassis* so far reported is from the Oligocene of Oregon, Washington, and the Indo-Pacific region. The Cook Mountain Formation species *Phalium brevicostatum* (Conrad, 1834) is easily separated from *P. (S.) reklawensis* by its more elongate shape and ornamentation of flat spiral ribbons and incised grooves. The Weches formation furnishes a *Phalium* sp. with characters midway between the Cook Mountain and Reklaw species. A species with a similar sculpture, but somewhat less related is *Phalium (Semicassis) caela-*

tura (Conrad, 1848b), from the Lower Oligocene, Vicksburg Group. This species is more elongated, has a very weak shoulder, a rounded outer lip, and possesses a deep, strongly bent back, anterior notch rather than the short, almost unnotched, canal seen in *P. (S.) reklawensis.*

Etymology.—Noting the Reklaw Formation where the species occurs.

Type information.—Holotype: PRI 30373. Type locality: locality 8. Paratype: UT-TMM 3581, locality 10.

Material examined.—40 specimens, the largest of which (the holotype) is 20 mm in length.

Family **FICIDAE** Meek, 1864, p. 32

Genus **FICOPSIS** Conrad, 1866b, p. 100

Type species.—Hemifusus remondii Gabb, 1864, by subsequent designation (Stewart, 1927, p. 375). Martinez Eocene of California.

Diagnosis.—Shell more or less inflated, with a low spire and a long beak; sculpture usually cancellate or with crenulated spirals; aperture elongate with a long and twisted siphonal canal.

Remarks.—This genus is restricted to the Eocene of Europe and North America.

Ficopsis nucleoides, new species
Plate 14, figures 3–5

Description.—Shell small, whorls six, protoconch consists of three and a quarter to three and a half smooth whorls of which the last quarter to one-half whorl may show faint curving irregular striae on the abapical half. The first half whorl is in line with the shell axis while the rest of the protoconch is at an acute angle of 20° to 30°. The adult sculpture consists of a cancellate ornament of longitudinal and spiral lirae, the spiral lines crossing over the longitudinal ones. On the beak the longitudinal lirae are weaker and the spiral ones alternate in size. Generally one varix occurs on the first adult whorl, and in older specimens also on the body whorl. The body whorl is bicarinate with four to seven spiral lines on the shoulder which tend to alternate in size. Labrum sharp and in some specimens thickened within.

Remarks.—The longitudinal costae on several specimens are so prominent that they could almost be regarded as costae. The medial carination of the body whorl is another relatively variable character, strong in some specimens and almost obsolete in others. The species combines the larger nucleus, greater number of lines on the shoulder and the carinate body whorl of *Ficopsis penita* (Conrad, 1833a) that ranges from the Weches Formation to the Gosport Sand Formation, with the obtuse apex, varices and the tendency to form longitudinal folds of *Ficopsis texana* (Harris, 1895a), known from the Cook Mountain Formation of Texas and the McBean Formation of South Carolina; it is probably ancestral to both. The larger flattened protoconch is the primary character differentiating these specimens from *F. penita* and *F. texana.*

Etymology.—The specific name *nucleoides* (Latin, nucleus) refers to the large inflated nucleus.

Type information.—Cotypes: PRI 30374–30375; paratypes: PRI 30376, 30377. Type locality: locality 20.

Material examined.—109 specimens, the largest complete one: 10.2 mm length, 5.1 mm width.

Suborder **PTENOGLOSSA** Gray, 1853b, p. 129

Superfamily **TRIPHOROIDEA** Gray, 1847a, p. 154[9]

Family **CERITHIOPSIDAE** H. and A. Adams, 1853, p. 239

Subfamily **CERITHIOPSIINAE** H. and A. Adams, 1853, p. 239[10]

Genus **CERITHIOPSIS** Forbes and Hanley, 1851, p. 364

Type species.—Murex tubercularis Montague, 1803, by monotypy. Recent in European Seas.

Diagnosis.—Shell small, slender, turrited, protoconch whorls smooth, axially ribbed, longitudinally lirate or a combination of the above. Adult whorls ornamented with tuberculated or beaded spiral cords. Aperture oval or rounded rectangular in shape, columella short, slightly twisted.

Remarks.—The genus is known from the Upper Cretaceous to Recent. The animals are all marine and reported to feed on sponges.

Subgenus **CERITHIOPSINA** Bartsch, 1911, p. 328

Type species.—Cerithiopsis (Cerithiopsis) necropolitana Bartsch, 1911, by original designation. Pleistocene of the San Pedro Group, Deadmans Island, California.

Diagnosis.—Differs from *Cerithiopsis* s.s. by having the initial portion of the protoconch whorls smooth and the final portion axially ribbed.

Remarks.—The subgenus ranges from the Eocene to Plio-Pleistocene.

Cerithiopsis (Cerithiopsina?) sp.
Plate 12, figures 8–9

Description.—Shell very small, slender, of nine whorls. Protoconch "*Gemmula* like", of five whorls,

[9] *Nomen transl.* Kosuge, 1966.

[10] *Nomen transl.* (*ex* subfamily Adams, H. and Adams, A, 1853, p. 223, not 1854 of authors).

the tip partially immersed; the first whorl smooth and the remaining ones with increasingly protractive riblets. Transition to teleoconch sharp and angular. Adult whorls with concave ramp and three spiral lines on the ramp, the lines crossing over sharp longitudinal folds that die out before reaching the suture. Body whorl with six spiral lines, the fourth from the suture the largest and the anterior two the weakest. Outer lip sharp, aperture oval, columella slightly thickened. No anterior canal or spout.

Remarks.—It is conceivable this small shell is the juvenile of *Bittium ridgei* n. sp., due to some similarity in the early whorls, but the present collections of *B. ridgei* show so little variation that this seems unlikely. Were the protoconch absent there might be little hesitation in assigning the specimen to *Bittium s.l.,* but the multiwhorled ornamented protoconch precludes that. A monotypic recent genus with similar sculpture is *Eumetula* Thiele, 1912, from the Antarctic; this genus has a thickly ribbed protoconch whorl, a similar whorl profile and similar teleoconch sculpture with two spiral lines. Another species in which the teleoconch sculpture is markedly similar is *Cerithiella dertobcarinata* Sacco, 1895, from the Miocene (Tortonian) of Italy, of which the protoconch is unknown.

Figured specimen: PRI 30378, from locality 4.

Material examined.—One specimen 2.0 mm in length.

Superfamily **JANTHINOIDEA** Lamarck, 1812, p. 204

Family **EPITONIIDAE** Suter, 1913, p. 318[11]

Genus **AMAEA** H. and A. Adams, 1853, p. 223[12]

Type species.—Scalaris magnifica Sowerby, 1844a, by subsequent designation (de Boury, 1909, p. 258). Recent from the Pacific Coast of Japan.

Diagnosis.—Shell high, thin, shining; whorls inflated, with numerous longitudinal and spiral lines or threads, sometimes with a few thin irregular varices; basal disc defined by a prominent line; aperture ovate to quadrate.

Remarks.—The genus is known from the Cretaceous to Recent.

Subgenus **SCALINA** Conrad, 1865a, p. 27

Type species.—Scalaria staminea Conrad, 1860, by subsequent designation (Palmer, 1937, p. 102). Eocene, Gosport Sand Formation of Alabama.

Diagnosis.—Whorls regularly rounded; whorls reticulated with axial costae and spiral ridges, the axials finer and less crowded together than the spirals, the interstices of the spirals with fine linear grooves. Basal disc conspicuous and with fine cancellate ornament.

Remarks.—Modern representatives live in deep water. The genus ranges from the Eocene to Recent.

Amaea (Scalina) macula, new species
Plate 12, figures 1–2

Description.—Shell high, turrited, with at least three smooth and rounded nuclear whorls. Adult whorls covered with numerous lamellose costae which cross over six to seven broad, rounded spiral lines, curve forward and become almost tangential at the posterior suture, and then finally disappear beneath the preceding whorl. Whorls slightly shouldered, the shoulder free of spiral lines. Basal disc present and margined by a strong nodular revolving cord, the nodules appearing where the ribs cross over the cord. The ribs continue to the obscure fasciole as rounded lamellae, where they then bunch up and become a fringe at the peristome. Aperture oval with the lower margin slightly reflected; outer lip not thickened. The body whorl of a complete specimen with 38 ribs, a larger broken specimen with 48 ribs on the body whorl.

Remarks.—The bent axial ribs, spiral sculpture, lack of varices and the basal disc with the close-set spiral and radial lines place this species in *Scalina.* The closest species is *Amaea (Scalina) staminea* (Conrad, 1860) from the Gosport Sand Formation; that species has a similar rounded whorl profile, axial ribs which meet the posterior suture at an acute angle, and a weak cord margining the basal disc, the disc itself being almost smooth. More distantly related are Amaea (*Scalina) trapaquara* (Harris, 1895a) and *Amaea (Scalina) trapaquara engonata* (Harris, 1895a) from the Cook Mountain and Weches formations respectively; these two species have a fairly prominent concave upper whorl profile, axial ribs that meet the suture almost at right angles, and no cord margining the basal disc. Perhaps the commonest species of Epitoniidae from the Gulf Coast Eocene is *Cirsotrema (Coroniscala) nassulum* (Conrad, 1833a), to which it bears a general, although superficial resemblance; that species has almost no macro spiral sculpture.

Etymology.—the name *macula* (Latin, mesh), refers to the pattern generated by the equally sized spiral and longitudinal lines.

[11] Many authors incorrectly ascribe the family name Epitoniidae to Berry (1910), probably a mistake for de Boury (1910). In that paper de Boury does discuss Dall's use of the genus *Epitonium* instead of *Scala* in connection with the validity of the Bolton catalogue, but was not in favour of using it. Dall apparently first uses the genus *Epitonium* instead of *Scala* in Dall (1909b, p. 52), after a discussion some years earlier (Dall, 1889b, pp. 315–317). The first author to actually use the family name Epitoniidae seems to be Suter (1913).

[12] *Nomen transl.* (*ex* family Adams, H. and Adams, A, 1853, not 1854 of authors).

Type information.—Holotype: PRI 30350; paratype: PRI 30351. Type locality: locality 20.

Material examined.—79 specimens, the largest complete 12.0 mm in length.

Subgenus **FORATISCALA** de Boury, 1887a, p. 28

Type species.—*Scalaria cerithiformis* Watelet, 1853, by original designation. Eocene (Cuisian) of Hérouval, France.

Diagnosis.—Shell small, narrow and thin-shelled. Whorls inflated, with deeply impressed sutures, ornamented with longitudinal lamellar ribs and revolving axial lines of similar strength. Basal disc present, separated from the body whorl and the wide umbilicus by strong cords. Aperture oblique, not entire, outer lip thin.

Remarks.—The presence of the umbilicus distinguishes this taxon from other similar ones. The genus is known from the Paleocene to Eocene.

Amaea (Foratiscala) texana, new species
Plate 12, figures 3–4

Description.—Shell small, whorls at least eight, tip of spire worn. Whorls rounded, very slightly shouldered and ornamented by five spiral lines and numerous longitudinal lines, the shoulder free of spiral lines. Basal disc present, margined by a strong cord, the disc with weak spiral lines and weaker longitudinal ones, these are the continuation of the longitudinal lines ornamenting the whorls and continue into the umbilical area as fine lamellae. The posterior part of the umbilicus with a thin covering of callus that spreads over the upper part of the basal disc.

Remarks.—Even though this specimen is a little worn, it appears to be closely related to *Amaea (Scalina) macula* from the Reklaw Formation. *A. (F.) texana* has the same number of spiral lines, a similar whorl profile with only a slightly more prominent shoulder, and stronger spiral than longitudinal lines. It is the character of the basal disc, however, where the differences are greater, in *A. (S.) macula* the longitudinal lines end in a "frill" against the columella whereas here they run into the umbilicus without bunching up. The similarity of the spire to *A. (S.) macula* could be taken as variation within a species living in different environments, as *A. (S.) macula* is found in a clay/shale (lagoonal) matrix while *A. (F.) texana* was collected from an indurated sandstone/ironstone layer, which is taken as representing clearer waters and a near-shore higher energy environment. Species of the subgenus *Foratiscala* are relatively rare; Cossmann and Pissaro (1910–1913, pl. 8), list four species from the Paris Basin Tertiary ranging from the Cuisian to the Bartonian. Wenz (1944) notes Recent species in the Indo-Pacific. The present species is allied to *Amaea (Foratiscala) sculptata* (Deshayes, 1861), apparently from the Cuisian, although this may be a mistake as Furon and Soyer (1947) do not include it under the Cuisian in their lists. This appears to be the first record of this subgenus in the Americas.

Etymology.—Referring to the discovery in Texas.

Type information.—Holotype: PRI 30352. Type locality: locality 7.

Material examined.—One specimen, 10.7 mm in length, 3.6 mm maximum diameter.

Genus **RUGATISCALA** de Boury, 1913, p. 72

Type species.—*Scalaria levesquei* de Boury, 1887b, by original designation. Eocene (Cuisian) of the Paris Basin, France.

Original diagnosis.—"Testa solida, imperforata, eleongoturrita, costis longitudinalibus crassis et fimiculis transversis incrassatis ornati. Sutura mediocriter profunda. Anfractibus convexi, costis longitundinalibus crassis funiculis incrassatis impressi et nullo modo punctati. Ult anfra. spira minor, disco praditus. Apertura subrotunda. Peritoma duples. Internum continuum crassiusculum, vix prominulum, nitidum. Externum, postice interruptum, crassum et altema varice costitutum." (de Boury, 1913, p. 72)

Free translation.—Shell solid, not umbilicated; whorls inflated with bent axial ribs and (non-punctate) spiral lines; suture impressed. Basal disc concave, weakly spirally striate. Aperture oval, outer lip duplex, apertural varix present.

Remarks.—The genus ranges from the Eocene to the Miocene.

Rugatiscala cooperi, new species
Plate 12, figure 6–7

Description.—Shell small, tip of protoconch missing, three finely ribbed whorls remaining, the ribs feebly arcuate and continuous. Teleoconch with eight and a half whorls. Whorls with rounded longitudinal costae, 15 on the last whorl, the entire area crossed by five low rounded ribs that are larger medially and also more pronounced between the costae. Surface with an opalescent sheen, not punctate. Basal disc present, margined by a flat ribbon and with ten close-set spiral lines, the profile slightly concave with feeble radial undulations corresponding in position to the costae. Aperture ovate, peristome continuous, abaperturally duplex and slightly produced; minute umbilical slit present.

Remarks.—This species might be placed in *Rudiscala* (de Boury, 1909), due to the similarity to *Rudiscala harrisi*, Palmer, 1937 from the Lower Eocene Hatchetigbee Formation, and *Rudiscala sessilis* (Con-

rad, 1833b) from the Gosport Sand Formation; *R. harrisi* has the same number of ribs and the same minute crowded spiral sculpture. *R. harrisi* however, has an umbilical chink, lacks any larger spiral lines, and has a smooth multi-whorled protoconch quite unlike that of *R. cooperi.* The radically different protoconch in itself points at *R. cooperi* belonging to a different genus than *R. harrisi* and *R. sessilis* although the generally similar teleoconch sculpture is confusing. Cossmann, (1912, p 80) includes *Rudiscala* under *Turriscala* de Boury, 1890; Wenz (1940, pp. 792–793) places *Rudiscala* in synonymy with *Turriscala* and also includes *Rugatiscala* under the latter. Palmer (1937, p. 108) cites de Boury's review of *Turriscala* and *Rudiscala* where the differences are noted and gives *Rudiscala* full generic rank. For the same reasons I also prefer to give *Rugatiscala* full generic rank.

Etymology.—Named in honor of John Cooper of the Natural History Museum, London

Type information.—Holotype: PRI 30353. Type locality: locality 4.

Material examined.—One specimen, 5.4 mm in length.

Rugatiscala? sp.

Remarks.—One incomplete specimen was found of this species. There are seven and one-half remaining whorls; the nuclear whorls and half the body whorl are missing. The whorls are ornamented with strong, fairly sharp-topped axial ribs, 16 on the final whorl, all overriden by 17–20 spiral lines, those nearer the suture more crowded together. The basal disc is concave, and covered with spiral lines the one nearest the periphery about twice the size of the others. This species is distinguished from *Rugatiscala cooperi* n. sp. by the more numerous spiral lines and axial ribs, and the lack of an opalescent surface sheen. A similar species is *Rudiscala harrisi* Palmer, 1937 from the lower Eocene, Hatchetigbee Formation; this species is more elongate, has spiral lines of a punctate character, and a slight groove in the umbilical region. Two characters that are diagnostic of *Rugatiscala* are the terminal varix on the outer lip and the duplex character of the peristome at the columella. As both these characters cannot be seen due to the damage, the species is only doubtfully referred to this genus.

Type information.—Figured specimen: PRI 33124, 5.1 mm length.

Superfamily **EULIMOIDEA** H. and A. Adams, 1854, p. 235

Family **EULIMIDAE** Troschel, 1853, p. 112

Genus **MELANELLA** Bowdich, 1822, p. 27

Type species.—Melanella dufresnii Bowdich, 1822, by monotypy. Recent in the Indo-Pacific region.

Diagnosis.—Shell white, polished; last whorl produced, inner lip appressed for at least the greater part of the attenuated base; shell straight or flexed.

Remarks.—MacNeil and Dockery (1984), may be consulted for a discussion on the validity of *Melanella.* The animals are carnivorous, believed to be always associated with echinoderms. The genus ranges from the Upper Cretaceous to Recent.

Melanella minutissima, new species
Plate 23, figures 20–21

Description.—Shell minute, whorls six. Protoconch of one whorl merging smoothly into the adult whorls. First three to four adult whorls moderately convex with impressed sutures, thereafter almost flat, with a slight subsutural depression and flat and indistinct sutures. Aperture tear-drop shaped, outer lip thin and parasigmoidal, the maximum width occurring where the body whorl begins to curve towards the base. Columella slightly twisted and oblique.

Remarks.—This might be taken as the juvenile of the next species but the initial rounded whorls and parasigmoidal outer lip will separate the two species. The type of outer lip is similar to that exhibited by *Rissoina* d'Orbigny, 1840a, of which a Claibornian representative is *Rissoina (Leanella) cossmanni* (Aldrich, 1910b). The present species lacks the thickened outer lip and channeled sutures of that species. The Reklaw species combines characters of both *Melanella* and *Leanella* Cossmann, 1921, two taxa presently placed in different families. The rounded initial whorls and the impressed sutures of *M. minutissima* separate it from other Claibornian and Jacksonian species of the genus.

Etymology.—Noting the minute size of the species.

Type information.—Holotype: PRI 30546; paratype: PRI 30547. Type locality: locality 20.

Material examined.—Seven specimens, the largest 1.5 mm length.

Melanella cf. notata (I. Lea, 1833)
Plate 23, figures 22–24

Pasithea notata I. Lea, 1833, p. 101, pl. 4, fig. 80; H. C. Lea, 1849, p. 103; Harris, 1895c, p. 30.

Cf. *Pasithea lugubris* I. Lea, 1833, p. 101, pl. 4, fig. 81; H. C. Lea, 1849, p. 103; Harris, 1895c, p. 26.

Pyramis notata (I. Lea). Conrad *in* Morton, 1834, p. 4.

Eulima notata (I. Lea). Conrad, 1865a, p. 29; 1866a, p. 14; de Gregorio, 1890, p. 162, pl. 16, fig. 6, copy I. Lea.

Cf. *Eulima lugubris* (I. Lea). Conrad, 1865a, p. 29; 1866a, p. 14; Meyer, 1887b, p. 54, pl. 3, fig. 8; de Gregorio, 1890, p. 161, pl. 16, fig. 5a copy Meyer, fig. 5b copy I. Lea; Cossmann, 1893, p. 24, pl. 2, fig. 3; 1921, p. 193.

? *Turbonilla lugubris* (I. Lea). Dall, 1892, p. 255.

Not *Rissoina notata* (I. Lea). Cossmann, 1893, p. 27, pl. 1, fig. 34 = *Eulima cossmanni* Aldrich, 1910.

Not *Rissoina (Leaella) notata* (I. Lea), Cossmann, 1921, p. 91, pl. 3, figs. 59, 60 = *Eulima cossmanni* Aldrich, 1910.
Melanella notata (I. Lea). Palmer, 1937, p. 61, pl. 6, figs. 20, 26–30; pl. 79, fig. 1 type; Brann and Kent, 1960, p. 541; Glibert, 1962b, p. 257.
Balcis notata (I. Lea). Palmer and Brann, 1966, p. 523; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 28, 30.

Original description.—"Shell subulate, highly polished; substance of the shell rather thick; apex acute; suture very small; whorls eleven, very flat, each one being marked with an impressed oblique line of growth; mouth small, acutely angular above, about one-fifth the length of the shell; columella somewhat thickened at the base; outer lip somewhat arched, with an obtuse edge." (Lea, 1833, p. 101)

Remarks.—The species is smaller and slightly slenderer than *Melanella notata* s.s. from the Gosport Sand Formation, but otherwise similar. It shows well the impressed line of growth on each whorl. Two well-preserved specimens have a glassy lustre and show the sutural area as a light colored band.

Type information.—Holotype: ANSP 5495. Figured Reklaw specimen: PRI 33105, from locality 14.

Material examined.—15 specimens, the largest (crushed) 8 mm length.

Melanella aff. **extremis** (Aldrich, 1911)
Plate 23, figure 19

Eulima extremis Aldrich, 1911, p. 8, pl. 3, fig.4; Palmer and Brann, 1966, p. 667.
Melanella extremis (Aldrich). Palmer, 1937, p. 65, pl. 6, figs. cf. 8, 9, 13 copy Aldrich, cf. 14, 15, cf. 21; Brann and Kent, 1960, p. 540.

Original description.—"Shell polished; whorls nine or ten; suture very shallow showing indistinctly; aperture elongate; outer lip slightly sinuous; inner lip reflected over the lower part of the pillar." (Aldrich, 1911, p. 8)

Remarks.—One crushed specimen was obtained of a very slender *Melanella* with the same shining polished surface seen in *M. extremis,* from the Middle Eocene.

Type information.–Holotype: USNM 1963 (lost *fide* Palmer and Brann, 1966, p. 667). Figured specimen: PRI 30417, 8.2 mm length, from locality 20.

Order **NEOGASTROPODA** Wenz, 1938, p. 71[13]
Superfamily **MURICIOIDEA** da Costa, 1776, p. 224
Family **MURICIDAE** da Costa, 1776, p. 224
Subfamily **MURICINAE** Rafinesque, 1815, p. 18
Genus **HEXAPLEX** Perry, 1811, pl. 8, fig. 4

Type species.—Murex chichoreum Gmelin, 1791, by subsequent designation (Iredale, 1915, p. 471). Recent, the Philippines.

Diagnosis.—Shell solid, usually quite large. Spire moderate to high, whorls with five or more spinose, foliated or knobbly varices and having spiral cords. Aperture large and ovate, canal short, recurved and partially obscured.

Remarks.—Hexaplex is similar to *Chicoreus* Montfort, 1810, except for the number of varices. Vokes (1968 pp. 86–87) gives a discussion particularly applicable to Tertiary members of the group. The distribution is principally tropical and subtropical in extent and in depths of 0 to 300 meters. The genus is known from the Eocene onward.

Hexaplex eoa, new species
Plate 14, figures 8–9

Description.—Shell small, high spired. Protoconch missing in all available specimens. Whorls at least six, rounded and with a flat to slightly convex prominent ramp; below the ramp with two or three spiral cords, the uppermost on the carina and almost effaced except on the varix. Body whorl with about 11 large cords becoming less prominent on the beak. Between the cords the surface shows numerous irregular spiral striae, stronger on the ramp, and an occasional intermediate spiral line. Early whorls with eight to nine foliated spinose varices, later whorls with 10 to 11; the tips of the spines strongly retractive. Aperture elliptical, outer lip with an open channel extending to a large spine; five prominent denticles below the spine, columella lip smooth, siphonal canal moderate in length.

Remarks.—This species belongs to the Claibornian group consisting of *Hexaplex (Hexaplex) texanus* Vokes, 1968, *Hexaplex (Hexaplex) silvaticus* (Palmer, 1937) and *Hexaplex (Hexaplex) vanuxemi* (Conrad, 1834). The present species is closest to the Weches species *H. (H.) texanus* and may be distinguished from it by the higher spire, the weaker posterior spiral cord and the lack of columella denticles. Both specimens are rather worn and were found embedded in extremely fossiliferous ironstone boulders occurring at the very top of the Marquez Member, the deposition of which is presumed to have been a near-shore environment. Despite the wear it can be seen that *H. (H.) eoa* is more prominently spinose that the other three species. This appears to be the oldest species of *Hexaplex* known within the limits of the genus as defined by Vokes, 1968, extending the the limits of the genus into the Reklaw.

Etymology.—The name *eoa* (Latin, dawn), refers to the dawn of the genus.

Type information.—Holotype: PRI 30381; paratype: PRI 30382. Type locality: locality 7.

Material examined.—Two specimens, the largest (the holotype) 15.0 mm in length.

[13] Replacement name for Stenoglossa Bouvier, 1887.

Genus **PTERYNOTUS** Swainson, 1833, pl. 100

Type species.—Murex pinnatus Swainson, 1822, by subsequent designation (Swainson, 1822 pl. 122). Recent in the Indo-Pacific.

Diagnosis.—Small fusiform shells with three winged varices, siphonal canal usually open, columella lip adherent and smooth, spiral lines usually present.

Remarks.—Few modern members are known of this genus and those usually live in deep water. The group existed from the Early Paleocene and was relatively common especially in the Tertiary of the London and Paris Basins.

Subgenus **PTERYNOTUS** s.s.

Diagnosis.—Outer lip entire and without denticles, siphonal canal slender, open and recurved.

Pterynotus (Pterynotus) cf. **stenzeli** Vokes, 1970
Plate 14, figures 11–12

Pterynotus (Pterynotus) stenzeli Vokes, 1970, p. 8, pl. 1 fig. 5, 1992, p. 5, pl. 1, fig. 3; Harasewych and Jensen, 1979, no. 22, p. 3.

Remarks.—One specimen obtained of this species. The shell is unfortunately missing the outer lip, and without the presence of labral denticles and an open apertural spine cannot definitely be assigned to *P. (P.) stenzeli*; previous varix growth stages, however, show indications of the presence of such earlier spines. At six and a half whorls and 12.3 mm in length, the shell is smaller and slightly shorter than the typical Weches form, but this is not considered important enough for taxonomic separation. It does also appear that previous spines occurred above the carina unlike in *P. (P.) stenzeli* where they are positioned on the carina; if better specimens should validate this fact, the Reklaw forms may have to be separated.

Type information.—Holotype: TBEG 36637. Type locality: TBEG 173-T-19, 6.4 km west of Chireno; hill on San Augustine road (Texas Highway 21), Nacogdoches County, Texas. Figured Reklaw specimen: PRI 33126, from locality 4.

Superfamily **BUCCINOIDEA** Rafinesque, 1815, p. 145

Family **COLUMBELLIDAE** Swainson, 1840, p. 61

Genus **MITRELLA** Risso, 1826, p. 272

Type species.—Mitrella marmin Risso, 1826, by original designation. Recent in the Mediterranean.

Diagnosis.—Shell medium-sized, moderately slender, spire high, pillar slightly constricted. Nucleus slender, consisting of about one and a half bulging whorls, the first part rather loosely coiled. Aperture relatively wide. Anterior canal virtually absent, the outer lip extending down to base of aperture without any constriction. Siphonal notch shallow. Columella slightly bulging at base. Inner lip bearing slender denticles. Parietal callus thin except at posterior channel. Outer lip somewhat varicose, bearing a very shallow broad notch near suture, the interior bearing heavy denticles. Sculpture limited to weak spiral cords on pillar (Woodring, 1928, p. 273).

Remarks.—Nine species are found in the Paleogene of the Gulf costal plain. The group expanded greatly in Miocene times, with Gardner (1947) noting 22 species in the Alum Bluff Group of Florida. Abbott (1974) records 23 species from the Atlantic and Gulf coast provinces of the U.S. The genus is widely distributed today in warm and shallow waters.

Subgenus **CLINURELLA** Sacco, 1890, p. 44

Type species.—Columbella (Clinurella) scalaris Sacco, 1890, by subsequent designation (Palmer, 1937, p. 281). Miocene of Italy.

Diagnosis.—Shell small, turrited, spire high with an acute apex. Spire whorls smooth, straight-sided, sometimes with a subsutural spiral line. Body whorl with a few spiral lines on the base. Canal short, wide and somewhat off-center. Columella excavated, smooth; labrum crenulated or with short lirae.

Mitrella (Clinurella) nuttalli, new species
Plate 14, figures 15–17

Description.—Apical area of the larger specimens somewhat eroded. Juvenile specimens show a high conical protoconch of four and three-quarter whorls, the first two and one-half smooth, the next one and a quarter with close-set longitudinal threads that are bounded at the abapical suture by a spiral thread. Adult sculpture begins sharply and consists of smooth, straight-sided whorls with two equally sized threads below the suture and a groove of the same size above the suture. On large specimens the number of revolving lines may increase to four by the penultimate whorl; the body whorl lirate from the subsutural line to the base, the lines alternating in size. Outer lip crenate with five to nine lirae. Columella concave above, sometimes with a swelling on the lower margin; below reflected and moderately twisted.

Remarks.—This species has affinities to both *Mitrella (Clinurella) bucciniformis* (Heilprin, 1879) and *Mitrella (Columbellopsis) mississippiensis* (Meyer and Aldrich, 1886), both from the Upper Claiborne Group; *M. (C.) mississippiensis* has a smaller smooth area on the body whorl, a shorter canal, three tubercles on the columella and seven denticles on the labrum (not lirate as in *M. (C.) nuttalli*); *M. (C.) bucciniformis* has more prominently convex whorls, only one subsutural line

on the later spire whorls, a larger smooth area on the body whorl and no twist to the canal. The crenate labrum and smooth inner lip place *M. (C.) nuttalli* in subgenus *Clinurella*.

Etymology.—Named in honor of Clive P. Nuttall formerly of the Natural History Museum, London.

Type information.—Holotype: PRI 30383; paratype: PRI 30384, a juvenile. Type locality: locality 20.

Material examined.—18 specimens, the largest: 9.5 mm length, 4.7 mm width.

Mitrella (Clinurella) nuttalli lineata, new subspecies
Plate 14, figures 1–2

Description.—Shell small, thick shelled, to six and three-quarter whorls. Protoconch of three and a half whorls, usually all smooth, sometimes the final eighth with widely spaced indistinct riblets. Adult whorls convex, sutures impressed and in the center of a prominent channel. The whorls of the spire have a sculpture of flat-topped spiral bands, the bands wider than the interstices. Early whorls with one or two bands below the suture and by the fifth whorl the number of bands has increased to five. The body whorl with 15 main spiral bands, alternating with an equal number of smaller ones, becoming subequal in size towards the anterior end. Lines of growth very weak and parasigmoidal. Aperture elongate-elliptical, slightly more than half the total length of the shell, notched posteriorly and with a straight channel below. Outer lip worn, but apparently was thin-edged, labrum with ten strong lirae starting some distance behind the outer edge. Columella excavated above, the margin to the channel with a thick deposit of callus and one small denticle at the posterior end. Umbilical depression beside the large siphonal fasciole.

Remarks.—The different protoconch will separate this subspecies from *Mitrella nuttalli* immediately, without it the shorter form, thicker shell and more evenly lirate sculpture can be used. This species is close to *Mitrella alabamensis* (Aldrich, 1895) from the Hatchetigbee Formation of Alabama. The Alabama specimen is a thinner shelled and slenderer species, has denticles on the outer lip, a greater number of revolving lines on the spire and a more pronounced curvature of the outer lip. This specimen has only one swelling at the lower end of the parietal area. The specimen combines characters of both *Mitrella* s.s and *Astyris* s.s. The species of genus *Mitrella* are generally smooth except for the base of the last whorl and possesses a smooth or slightly wrinkled columella, while *Astyris* possesses a channeled suture and a body whorl equal to half of the total length. This species, *M. alabamensis* and a so far unnamed species from the Weches Formation at Burleson Bluff, Brazos River, Texas, form a natural group, and could belong to a new genus but without a specimen with an intact protoconch it is considered premature to define it here.

Etymology.—The specific name *lineata* (Latin, line), refers to the very prominent spiral lines over the entire surface.

Type information.—Holotype: PRI 30385. Type locality: locality 20.

Material examined.—21 specimens, the largest (the holotype), 13.0 mm length, 6.4 mm width.

Genus **METULA** H. and A. Adams, 1853, p. 84

Type species.—Buccinum metula Hinds, 1845 (cited by H. and A. Adams as *Metula hindsii*) by tautonomy. Recent, Pacific coast of Panama.

Diagnosis.—"Shell medium-sized, moderately slender to very slender, whorls not or only slightly constricted at suture, body whorl very long. Nucleus stout, consisting of almost two smooth whorls. Aperture very long, narrow, elliptical, tapering to an acute angle at the posterior end, constricted at anterior end to form a short, wide, slightly recurved, moderately emarginate canal. Siphonal fasciole low. Edge of inner lip forming a definite edge along pillar and parietal wall. Outer lip varicose, its inner edge bearing broad denticles that may be extended into short lirations." (Woodring, 1928, p. 285)

Remarks.—Metula s.s. is known from the Oligocene to Recent. Woodring (1928), believed the Lower Eocene *Metula sylvaerupis* Harris, 1899 deserved subgeneric rank under *Daphnobela* Palmer (1937), and Palmer and Brann (1966) do not follow Woodring's suggestion, and keep the Eocene species from North America under *Metula* s.s.

Metula elongatoides, new species
Plate 15, figures 3–4

Description.—Shell small, very elongate, whorls eight and one-half, protoconch of three and a half whorls, the first two and a half smooth and conical, the final one almost cylindrical, smooth except for a final quarter turn of fine arcuate riblets that gradually increase in strength. Sutures impressed; whorls ornamented with numerous spiral lines, flatter on the lower half of the whorl, nodular on the upper half where crossed by growth lines. On later whorls a few spiral lines on the upper half of the whorl increase moderately in strength, the one margining the suture developing a duplex character. Very occasional weak varices sometimes present. Aperture and canal together a little less than one-third the total length of the shell; outer lip smooth, finely lirate within, not continuing

into the interior; columella straight, smooth, anterior canal short, bent to the left and weakly emarginate.

Remarks.—The protoconch places this species in *Metula*; it is the most elongate of all the *Metula* species known to me. In outline it is certainly closer to *Parvisipho* Cossmann, 1889, of which a few species are known from the Eocene of the Paris Basin.

Etymology.—Noting the extremely elongate form of this species.

Type information.—Holotype: PRI 30292; paratype: PRI 30293. Type locality: locality 4.

Material examined.—Eight specimens, the largest (the holotype) 12.9 mm long.

Superfamily **CYMATIOIDEA** Thiele, 1925, p. 90

Family **COLUMBRARIIDAE** Dall, 1909a, p. 213

Subfamily **COLUMBRARIINAE** Dall, 1909a, p. 213

Genus **PSEUDOMETULA**, new genus

Type species.—*Metula gracilis* Johnson, 1899, no. 7005 ANSP, herein. Middle Eocene, Cook Mountain Formation of Texas.

Diagnosis.—Elongate, finely cancellate *Metula*-like shells with varices usually a constant angular distance apart. Protoconch smooth, conical. The suture and varix encroaching onto the previous whorl. Callus plate absent in juvenile specimens, weakly developed in the adult. Outer lip weakly dentate or lirate. Anterior notch shallow.

Remarks.—The genus *Metula* H. and A. Adams, 1853 as known in the Americas includes two disparate groups of species. On the one hand there are the shells exemplified by the Recent *Metula amosi* Vanetta, 1913, *Metula metula* (Hinds, 1845), and similar fossil species such as *Metula gabbi* Brown and Pilsbry, 1911, from the Miocene Gatun Formation of Panama, and *Metula fastidiosa* Casey, 1903, from the Oligocene Red Bluff Formation. These species are long and ovate in shape, evenly cancellate, with a varicose outer lip and denticles on the inner edge; varices except for a possible terminal one are absent. The genus *Metula* has generally been placed in the Buccinidae although Woodring (1928, p. 287) notes it may belong in the Columbellidae. Woodring (1928, pp. 286–287) also believed that the American Eocene *Metula* species should receive subgeneric rank as the whorls of those species have a different shape, a less recurved and less deeply emarginate canal; he suggested that *Daphnobela* Cossmann, 1896b was available. In the Eocene through Oligocene there is a related group of species represented by *Metula sylvaerupis* Harris, 1899, *Metula brazosensis* Johnson, 1899, and *Metula gracilis* Johnson, 1899; these latter species are shorter, have regularly spaced varices that encroach on the preceding whorl, a columellar plate in the adult and a short canal. Woodring's suggestion to assign these latter species to *Daphnobela* is ill-advised; the type is the English Bartonian species *Metula junceum* (Solander, 1766, *non*: J. Sowerby, 1822); this species has a blunt paucispiral protoconch, a fine, evenly ribbed sculpture with occasional growth resting stages, and no varices and no denticles or lirae inside the outer lip. Cossmann (1896a, p. 93) places *Daphnobela* in the Pleurotomidae, whereas most modern authors place it in the Buccinidae as a subspecies to *Metula*. Keen's (1971, pp. 503–504, 509) diagnosis of *Columbraria* agrees well with the characters seen in the three Eocene species, *M. sylvaerupis,* M. *brazosensis* and M. *gracilis* and is remarkably similar to that of *Columbraria (Columbraria) lucasensis* Strong and Hertlein, 1937, and *Columbraria (Columbraria) siphonata* (Reeve, 1844) considering the long intervening time period. The columellar plate, such a prominent feature of modern members of this group, is usually absent in all but the larger Eocene shells but even in modern specimens is only fully developed in mature shells. The lack of a strong columella plate and the more fragile shell than *Columbraria* s.s is deemed sufficient to define this similar genus.

Pseudometula gradus, new species
Plate 15, figures 5–6

Description.—Shell small, fusiform. Protoconch of two and a half whorls, the tip inflated and partially enrolled, a single whorl of smooth, fine riblets appears on the next whorl after which the full cancellate ornament develops rapidly. Later whorls moderately stepped and ornamented with seven spiral lines, the two below the suture larger and wider apart than the remaining. The lines cross over numerous ribs, the intersections nodular. Body whorl with 26 or 27 spiral lines, nodular above the midsection and finer and more closely spaced below. Varices indistinct on early whorls, moderate in size on later ones and number about one per whorl. Outer lip with terminal varix, labrum with numerous equally spaced lirae the entire length of the inner lip and siphonal canal, the lirae continuous. Aperture elongate, canal short, slightly expanded basally and barely notched.

Remarks.—The closest American species is *Metula sylvaerupis* Harris, 1899, from the Hatchetigbee Formation at Woods Bluff, Tombigbee River, Alabama. That species has a different protoconch, a straighter canal, short denticles on the outer lip, and a heavier labial deposit.

Etymology.—The specific name *gradus* (Latin, step), refers to the stepped whorls.

Type information.—Holotype: PRI 30388; paratype: PRI 30389, a juvenile. Type locality: locality 4.

Material examined.—30 specimens, three adult, the largest 29.9 mm length.

Family **CYMATIIDAE** Pilsbry, 1922, p. 356

Genus **DISTORSIO** Roeding, 1798, p. 133

Type species.—*Murex anus* Linnaeus, 1758, by subsequent designation (Gray, 1847a, p. 133). Recent, Indo-Pacific.

Diagnosis.—Shells with distorted, gnarled apertures; periostracum hairy. Varix on outer lip, aperture more or less constricted, with prominent denticles and with a moderately long canal, columella shield broad.

Remarks.—Recent members of this genus inhabit the warmer waters of the Pacific, Indian and Western Atlantic oceans. The genus is known from the Eocene onward.

Subgenus **PERSONELLA** Conrad, 1865a, p. 21

Type species.—*Distorsio septemdentata* Gabb, 1860, by monotypy. Claibornian Eocene of the United States.

Diagnosis.—Shell size as *Distorsio* s.s. but with a wider aperture and smaller teeth; columella shield moderately broad.

Remarks.—The subgenus is restricted to the Eocene of North America and Australia.

Distorsio (Personella) nucleoides, new species
Plate 15, figures 11–13

Description.—Protoconch proportionately very large, of four and a half to four and three-quarters inflated whorls, about twice the size of the type of the subgenus. Nucleus minute and pointed, first one and a half whorls smooth, then developing widely spaced longitudinal striae which become close-set by the end of the nuclear whorls, and eight to nine fine spiral striae which start after the second whorl. Adult sculpture begins abruptly and consists of four revolving lines and numerous large ribs which form a reticulated ornament. The interstices have a finer secondary reticulation generated by numerous fine spiral and longitudinal threads. Each whorl generally has one large varix. Ribs obsolete on the lower half of the body whorl, canal moderately reflected and strongly twisted. Outer lip thickened within and bearing five to six denticles, the lower three moderate in size, above that a very small one and above that the two largest. Labial callus with two long denticles on the lower margin of the columella and three smaller ones above. The longitudinal ribs are visible under the upper part of the parietal callus.

Remarks.—This extends the known range of the genus to the lower part of the Claibornian. The Academy of Natural Sciences in Philadelphia has several specimens from the Reklaw Formation at Black Shoals on the Colorado River, Texas, which may be part of the lot sent to Heilprin in 1881; all of these specimens have a worn protoconch but are referable to this species. The emergence of this genus in America may actually have been slightly earlier since Stephenson (1953, p. 35) notes a mold referable to a possible *Distorsio* in sandstone stratigraphically below the Reklaw in northeastern Texas. The Reklaw species can easily be distinguished from *Distorsio (P.) septemdentata* Gabb, 1860, by the larger ornate protoconch. Without the protoconch one notes that *D. (P.) nucleoides* is slenderer with a spire angle of about 43° and four revolving nodular lines on the spire while *D. (P.) septemdentata* is much larger, has a spire angle of about 48°, three coarse nodular lines on the spire and becomes very much more distorted with age.

Etymology.—The specific name *nucleoides* refers to the inflated protoconch.

Type information.—Holotype: PRI 30390; paratype: PRI 33109. Type locality: locality 21.

Material examined.—83 specimens, the largest 8.6 mm length, 4.5 mm width.

Family **NASSARIIDAE** Iredale, 1916, p. 82

Genus **COLWELLIA** Nuttall and Cooper, 1973, p. 208

Type species.—*Colwellia fexuosa* Edwards *in* Lowry, Etheridge and Edwards, 1866, by original designation. Upper Eocene, Middle Headon beds, Isle of Wight, England.

Original diagnosis.—"Agrees with *Pseudocominella* except in the following respects: seldom exceeds 20 mm in height; protoconch of about two and a half smooth whorls, small, about 1 mm height, initially slightly flattened, first whorl very small; teleoconch with spiral and collabral sculpture of varying strengths; subsutural platform either poorly developed or absent; growth lines of fasciole broadly sinuous as in *Desorinassa*; outer lip often denticulate within." (Nuttall and Cooper, 1973, p. 208)

Remarks.—The genus is restricted to the Middle to Upper Eocene of Europe and North America.

Colwellia bilineata, new species
Plate 15, figures 7–8

Description.—Protoconch of two and a half to two and three-quarters smooth whorls, rounded and rapidly expanding, the first minute, flattened and partially immersed in the next. Adult sculpture begins with close-set very slightly curved longitudinal ribs upon which

two or three fine spiral lines develop just below the suture. The spiral lines gradually increase in size throughout the succeeding whorls forming a small concave ramp between them; longitudinal ribs rapidly decrease in size, except on the shoulder area where they form nodes at the intersections with the spiral lines. Each pair of nodes is connected by a short prosocline rib. Spiral lines weak on early whorls, becoming gradually stronger on later whorls, and well defined on the body whorl. A single plication on the lower margin of the columella. Siphonal fasciole bordered by a sharp line, callus deposit thin. A thickened area behind the outer lip.

Remarks.—In some specimens the longitudinal folds are entirely lacking and the revolving lines are free of nodes; specimens exist with all gradations between the smooth form and forms where the post-nuclear longitudinal ribs increase in size over the spire and then become obsolete again over the body whorl. A few specimens develop another finer line below the suture which may also become nodose. On two specimens all three spiral lines are equal in strength, close-set, and have a greater number of ribs and nodes. This seems to correlate with the presence of a small subsutural carina and may warrant subspecific rank although some intermediate forms do occur. Three American west coast species have been assigned to *Colwellia* by Nuttall and Cooper, 1973; this species and the next are the first to be recognized from the Gulf coast area. The character of the siphonal fasciole to which Nuttall and Cooper attached major importance in their diagnosis of *Colwellia* and similar genera, is duplicated almost exactly in this species. Anomalous is the far smaller size of this species, and the lack of denticulation within the outer lip, although few specimens do show some incipient development of that feature. A similar species is *Dorsanum* n. sp. from the Lower Eocene Sabinetown Formation of Texas, but *C. bilineata* may be separated by the subsutural lines of equal strength, the less prominent shoulder and the smooth medial area of the body whorl. A closely similar genus is *Desorinassa* Nuttall and Cooper, 1973, but that genus is distinguished from *Colwellia* by the absence of collabral sculpture, a convex ramp, and the lack of denticles and ribbing within the outer lip. Allmon (1990) has revised the *Bullia* group and recognizes *Colwellia* in the Middle Eocene of Britain and France, and possibly the Miocene of the West Coast of the U.S. I have collected juvenile specimens of *C. bilineata,* or a very similar species from the Seguin Formation, so the genus extends back at least to the base of the Lower Eocene. *Desorinassa* is recognised from the Paleocene to Lower Eocene.

Etymology.—The specific name *bilineata* (Latin, double line), refers to the lines on the shoulder.

Type information.—Holotype: PRI 30391; paratypes: PRI 30393, 30409. Type locality: locality 20.

Material examined.—104 specimens, the largest: 7.0 mm length, 4.0 mm width.

Colwellia sp.
Plate 15, figures 9–10

Remarks.—One specimen was obtained of a *Colwellia* with the outer lip broken but sufficiently distinct to be separated from *C. bilineata.* The nucleus is larger and more flattened than in the above species, the whorls have fine lines that increase in size towards the suture and are not abapically nodular. The whorl profile is rounded with no shoulder and a smaller portion of the body whorl is smoother than in *C. bilineata.*

Figured specimen: PRI 30438, from locality 20.

Material examined.—One specimen, 5.3 mm length, 3.0 mm width.

Genus **TRITIARIA** Conrad, 1865a, p. 21

Type species.—Buccinum mississippiensis Conrad, 1848, by monotypy. Oligocene of Mississippi.

Diagnosis.—Distinguished from species of the very similar genus *Phos* Montfort, 1810, by the more anterior position of the siphonal fasciole, the oval aperture and the protoconch with some collabral costellae.

Remarks.—A few species belonging to the closely similar genus *Antillophos* Woodring, 1928, live in the waters of Florida and the West Indies and are commonly found in sand in waters of shallow to moderate depths. The genus is known from the Eocene and Oligocene of America.

Tritiaria nodosa, new species
Plate 15, figures 16–17

Description.—Shell small in size, whorls eight, nucleus globular and slightly depressed, protoconch of two and a half to three rapidly enlarging whorls, the last one eighth to one quarter of which develop slightly inclined longitudinal folds. The adult sculpture begins with three or four spiral threads of which the lower three develop into thick lines which cross widely spaced collabral folds. Later whorls develop longitudinal lines midway between the original three. These increase in size until on the body whorl a reticulated sculpture is formed. Where the transverse lines cross the longitudinal ones prominent nodes are formed. Labial area margined below by a weak fold, usually with one denticle posteriorly, and more rarely two to four weak folds anteriorly. Siphonal fasciole bounded posteriorly by a large beaded cord which is composed of

five to six slightly smaller folds. Profile deeply notched, umbilical slit present.

Remarks.—On most adult specimens the longitudinal folds decrease in size becoming ribs; on some they are so small that a cancellate ornament is generated. In a few specimens the folds do not decrease in size and a more robust type of shell is developed. The change from folds to ribs usually occurs at about the seventh whorl; in a few specimens the ribs even change back to folds. Occasionally the labial ornament is intensified to such an extent as to form wrinkles over the entire surface, somewhat reminiscent of *Cassis*. The species is abundant in bed C of localities 12 to 23, but almost nonexistent in other beds. Three related species are *Tritiaria zacatensis* Gardner, 1945 from the Laredo Formation of Mexico, *Tritiaria hilli* (Harris, 1894) and more distantly *Tritiaria albirupina* (Harris, 1894), both from the Upper Eocene Jackson Group, of which the Mexican species *T. zacatensis* is the most similar. This species has an identical protoconch, similar but larger folds that do not die out on the later whorls, and, as is also the case with the other two species, no finer intermediate spiral and longitudinal lines.

Etymology.—The specific name *nodosa* (Latin, knotty), refers to the nodose character of the sculpture.

Type information.—Holotype: PRI 30394; paratypes: PRI 30395–30397. Type locality: locality 20.

Material examined.—126 specimens, the largest: 7.2 mm length, 3.1 mm width.

Genus **ANTILLOPHOS** Woodring, 1928, p. 259

Type species.—Cancellaria candei d'Orbigny, 1841a. Recent in the West Indies.

Original diagnosis.—"Shell medium-sized, moderately stout. Nucleus consisting of between three to four rapidly enlarging whorls, the last whorl bearing a spiral thread near anterior edge, above which, on the last quarter whorl, lie about five widely spaced, strongly curved, protractive axial riblets. Aperture moderately wide, forming a short, wide, deeply emarginate canal. Siphonal fasciole broad, low, limited by a narrow thread, bearing spiral threads and a weak axial groove, followed by a slight swelling. Edge of inner lip above basal fold bearing several irregular denticles. Parietal wall bearing a ridge near its posterior edge. Near base of outer lip lies a shallow stromboid notch. Interior of outer lip strongly lirate. Sculpture consisting of axial ribs and spiral threads." (Woodring, 1928, p. 259)

Remarks.—to date *Antillophos* has not been recognized earlier than the Miocene. MacNeil *in* MacNeil and Dockery (1984, p. 133) conjectured that *Terebrifusus amoenus* Conrad, 1833b might be a progenitor, but this seems unlikely given these specimens. Most authors treat *Antillophos* as a subgenus of *Tritiaria*; typical *Tritiaria* as recognised above under *T. nodosa*, however, is rather more widely separated from *Antillophos* than are the Miocene representatives of those two taxa. I therefore prefer to treat *Antillophos* as a full genus. The ancestors of this taxon should probably be looked for in *Sassia* or *Ranella*.

Antillophos multilineatum, new species
Plate 18, figures 10–13

Description.—Shell small to medium in size, whorls nine, protoconch of four smooth whorls, the tip swollen and partially enrolled, the last one-third with a weak spiral ridge and weak protractive riblets, transition to teleoconch sculpture gradual. Early teleoconch whorls angular with strong longitudinal folds, ten on the second teleoconch whorl; with age the whorls become more rounded, the folds increase to about 14 and then disappear on the last spire whorl; the final three whorls with one or two varices per whorl, the body whorl with one at the aperture. Spire whorls with six or seven raised spiral lines, the body whorl about 18, between each pair a weaker one and between those, one or two even weaker ones; where crossed by growth lines the spiral sculpture tends to nodularity. Aperture elongate, weak anal sinus present, outer lip broadly and weakly nodular within; inner lip with a posterior duplex parietal fold, anteriorly with a few weak denticles at the start of the short, weakly bent-back canal; siphonal fasciole strong; canal moderately notched.

Remarks.—Despite some similarity to *Sassia (Sassia) conradiana* (Aldrich, 1885), this species cannot be placed in that genus. Genus *Sassia*, as discussed by Wrigley (1932), and used in MacNeil and Dockery (1984), has a regular arrangement of varices spaced at equal angular intervals, a feature not seen in the Reklaw species; the lack of a bent-back canal, a wrinkled or lirate columella also confirm the separation. The subdued spiral ornamentation of the two Paris Basin species *Charonia (Sassia) formosum* (Deshayes, 1865) and *Charonia (Sassia) columbrina* (Lamarck, 1804) indicates some similarity, although both those species also have a bent canal. Palmer and Brann (1966, pp. 873–874) list four species of *Ranella* from the Paleocene and Eocene of the eastern and southern United States. None of these shows much similarity and in fact both the Paleocene *Ranella showalteri* (Conrad, 1860) and Lower Eocene *Ranella tuomeyi* Aldrich, 1886, appear to belong in *Sassia* if Wrigley's (1932) diagnosis is followed. With reference to published figures and diagnoses the closest species would appear to be *Eutritonium (Epidromus) autopsis* (Conrad, 1860). This species has not been rediscovered *fide* Harris

(1899, p. 66) and since neither locality or age is known, Palmer and Brann (1966, p. 675) recommended the species should be disregarded. If the generic characters described by Woodring are interpreted in a loose sense this species fits well in *Antillophos*. Well-preserved juvenile specimens show a faint carina or line in the lower quarter of the last protoconch whorl and the gradual development of numerous protractive riblets. The basal columellar fold, the labial lirae and posterior parietal-wall ridge are all present but very weakly defined. The stromboid notch is only seen on the two largest specimens and is very shallow. Very confusingly, juvenile and young adult specimens of this species have a form and ornament remarkably similar to Weches and Stone City specimens of *Streptochetus limulus* (Conrad, 1833b), only the conical, smooth protoconch and lack of columella notch can reliably distinguish the two taxa in the juvenile state. More mature specimens of *S. limulus* are easily distinguished by the squat form, the swollen subsutural collar and concave ramp, the terminal fold of the columella, and the twisted canal.

Etymology.—*Multi* (Latin, many) *lineatum* (Latin, lines), referring to the many fine spiral lines ornamenting the whorls.

Type information.—Holotype: PRI 30557; paratypes: PRI 30558, 30559. Type locality: locality 4.

Material examined.—15 specimens, the largest 20 mm length, 8.0 mm width.

Genus **BUCCINANOPS** d'Orbigny, 1841a, p. 434

Type species.—*Buccinum cochlidum* Dillwyn, 1817 (non Kiener, 1834), by subsequent designation (Gray, 1847a, p. 139). Recent, Brazil to Patagonia.

Diagnosis.—Shell bucciniform, usually thick and robust in appearance. Spire never greater than one-third shell height. Columella bears pronounced terminal fold. Internal sculpture almost always lacking. External sculpture usually simple. Parietal callus usually expanded onto body whorl but never thick. Anterior canal relatively wide and elongate. Sutures often enamelled. (After Allmon, 1990)

Remarks.—The genus is known from the Eocene onward.

"Buccinanops" ellipticum reklawensis, new subspecies
Plate 15, figures 14–15

Description.—Shell smooth, fusiform in shape, whorls shouldered, those of the spire slightly convex, body whorl strongly convex. Callus thick with an anterior swelling on the columella and typically extending over most of the spire. Longitudinal plications in spire weak to absent. A faint band below the suture shows sigmoidal lines of growth. Basal groove wide, margined above by a narrow band and occurring just below the center of the body whorl. The wide groove runs up to the siphonal fasciole and has an obsolete medial depression there corresponding to a thickening of the shell within the outer lip. An obsolete depression is present on the lower margin of the callus.

Remarks.—The Reklaw subspecies can be distinguished from *Buccinanops ellipticum* (Whitfield, 1865), a Lower Eocene species, by its more globose outline, the more prominently shouldered whorls and the basal groove occurring just below the center of the body whorl, rather than in the lower third as in *B. ellipticum* s.s. A similar, although slenderer species of *Buccinanops* occurs in abundance on the Little Brazos River at a locality which has been interpreted as being deposited in a high marsh environment with marine grasses. The fact that the genus is relatively uncommon in other localities where a marine or lagoonal environment is inferred suggests that the Reklaw species may have favored a similar habitat. Allmon, (1990, pp. 56–59) considered the placement of *B. ellipticum* to be problematical and probably not even in the family Nassariidae, no doubt partially due to the lack of the terminal columellar fold.

Etymology.—Referring to the Reklaw Formation where the species occurs.

Type information.—Holotype: PRI 30410. Type locality: locality 20.

Material examined.—16 specimens, the largest: 26.0 mm length, 14.5 mm width.

Genus **BULLIA** Gray, 1834, p. 596, pl. 37, fig. 8

Type species.—*Bullia semiplicata* Gray, 1834, by monotypy. Recent, off the coast of West Africa.

Original diagnosis.—"Animal without eyes; tentacles long and slender. Foot greatly expanded, and bifid behind. Shell ovate or turrited; spire more or less acuminated, sutures enamelled; inner lip excavated in the middle, callus posteriorly; aperture oval, moderate. (Gray, 1853, p. 112)

Remarks.—The genus is known from The Eocene onwards.

Bullia altilis harrisi Palmer in Price, 1928
Plate 15, figures 1–2

Bullia altile harrisi Palmer *in* Price, 1928, p. 29, pl. 7, fig. 7, 11, 12, 15.
Bullia altilis harrisi Palmer, 1937, p. 290, pl. 39, figs. 2, 3; Palmer and Brann, 1966, p. 543.
"Bullia" altilis (Conrad, 1832b). Allmon, 1990, p. 57.

Original description.—"Shell small, irregular in shape, flattened ventrally, protruded to the left, the anterior notch as in *B. altilis*; spire is usually depressed

and enveloped in the callus; the callus spreads posteriorly and laterally and covers the greater portion of the shell; usually three distinct, large nodes or bumps occur, one on the inner lip just above the middle, one on the dorsal side of the body whorl and one laterally in the middle, left portion of the body whorl. Many specimens have the tri-nodular character developed strongly and the spire so enveloped in the callus that the true generic identity of the form is obscured. There are specimens which show the anterior notch and groove of *Bullia*." (Palmer in Price, 1928, p. 29)

Remarks.—Two worn specimens were obtained which appear to be the above species. The species is known from the Queen City formation which adjoins the Reklaw formation on the Colorado River, near Smithville, Bastrop County, Texas. Allmon (1990, p. 58) considers that the *Bullia altilis* complex belongs to an undescribed genus, possibly in the Olividae, Ancillinae. The analysis necessary to confirm this however is not performed here, and the genus is left where it has been placed previously.

Type information.—Holotype: PRI 360; paratypes: PRI 356, 357. Type locality: Gazely Creek, Colorado River, near Smithville, Texas. Range: Reklaw and Queen City formations of Texas. Figured specimen: PRI 33127 from location 20.

Material examined.—Two specimens, the largest 18.0 mm length, 14.0 mm width.

Family **FASCIOLARIIDAE** Gray, 1850b, p. 67

Subfamily **FUSININAE** Swainson, 1840, p. 76

Genus **FALSIFUSUS** Grabau, 1904, pp. 80–81

Type species.—Fusus meyeri Aldrich, 1886, by original designation. Lower Eocene, Sabine Group of Alabama.

Original diagnosis.—"Shell fusiform with long and slender spire and a canal of about the same length. Protoconch merging into the whorls on the conch, no sharp demarkation being apparent. The first two whorls of the protoconch are generally smooth, the apical one minute, gradually increasing in size. The three to four whorls which constitute the apical series form a rather narrow cone. Third whorl with five closely crowded, more or less oblique riblets, which are in part gently concave forward. These after the completion of the third, or sometimes an additional whorl, quickly merge into the normal whorls of the conch. A basal carina usually marks the ribbed whorls of the apical series, this carina appearing just above the suture. Whorls of the conch as in *Fusus*." (Grabau, 1904, pp. 80–81)

Remarks.—Falsifusus was created for shells of fusoid form and a paucispiral protoconch of *Pleurotoma* type. The genus is known from the Upper Cretaceous to Recent.

Falsifusus ottonis (Aldrich, 1886)
Plate 16, figures 9–10

Fusus meyeri Aldrich, 1886, p. 21 in part, pl. 3, fig. 12.
Fusus ottonis Aldrich, 1897, p. 6 new name for *F. meyeri.*
Falsifusus meyeri (Aldrich). Grabau, 1904, p. 81, pl. 17, fig. 9.
Falsifusus ottonis (Aldrich). Wenz, 1943, p. 1260, fig. 1390.

Original description.—"Shell elongate fusiform, spire slender, acute; whorls fourteen; surface at the spire and body whorl with seven longitudinal folds, which are spirally arranged, crossed by raised rounded striae, generally seven in number, rather distant, the central one making a sharp carina on the center of each whorl, with erect longitudinal tubercles at the intersections; spaces between striae showing only lines of growth; canal very long, spirally striate with alternate raised lines; lines of growth very numerous and almost obsolete; mouth small, oblique-ovate; outer lip incurved, smooth. Locality: lower bed, Woods Bluff Alabama, Matthews Landing, Alabama." (Aldrich, 1887, p. 21)

Remarks.—On average the Reklaw specimens have fewer whorls and seven to nine spiral lines (most commonly eight) as against seven on those from the Sabinian Stage. The development of the longitudinal folds is a variable character and ranges from being obsolete to being so prominent as to cause the sutural line to be wavy. In one juvenile specimen the canal is one and a third the length of the spire and body whorl combined. This species, with minor variations, has been recognized from the Midway Group of Alabama to the Sabinian Stage, the present occurrence extending the range to the start of the Claibornian Stage.

Type information.—Holotype: USNM 638756. Type locality: Woods Bluff, Tombigbee river, Clarke County, Alabama. Range: Midway, Sabine to Claiborne. Figured Reklaw specimen: PRI 30447, from locality 21.

Material examined.—151 specimens, the largest 50 mm.

Genus **FUSINUS** Rafinesque, 1815, p. 145

Type species.—Murex colus Linnaeus, 1758, by monotypy. Recent, Indo-Pacific.

Diagnosis.—Shell large, spindle-shaped. Protoconch of one and a half whorls, usually smooth or with the last half whorl with axial riblets, terminated by a varix. Whorls convex, with spiral lines and usually with collabral ribs that disappear on the lower part of the body whorl. Body whorl with moderate to long neck and unnotched beak. Aperture ovate, gutter present, canal open, straight and generally twisted. Outer

lip serrate at edge, lirate within, edge of inner lip continuous along parietal wall. Columella weakly concave, folds absent, terminated in the adult by a parietal ridge.

Remarks.—The genus is well represented from the Miocene upwards in the Gulf and Atlantic coastal plains, and is widely distributed in warm waters today.

Fusinus claibornica, new species
Plate 16, figures 15–16

Description.—Shell large, whorls eight to nine, nucleus minute, protoconch of two and a half whorls, the last half whorl starting with faint spiral lines, then gradually developing faint collabral lines. Spire with nine to 11 rounded ribs per whorl that are overriden by many flat-topped spiral lines and smaller intermediate ones. Three large spiral lines dominate the sculpture of the early whorls and are situated below an indistinct shoulder, occupying a little less than half the whorl. Most lines tend to become subequal in size on the later whorls but some intermediate threads still occur. On the body whorl the entire spiral and collabral sculpture is much more subdued while on the beak it is more prominent again with the spirals alternating in size. Aperture ovate, widely and weakly channeled above, outer lip serrate and with widely spaced lirae within. Columella weakly excavate, terminated below by a ridge, canal twisted. Parietal wall forming a large umbilicus in the adult, very small in the juvenile, the left hand side margined by a prominent siphonal fasciole.

Remarks.—It is possible that two very closely related species are at hand as two individuals have a slightly greater apical angle and about one more costa per whorl. Whether this represents two species or the variation within one must wait for the discovery of further specimens. The species closest to *F. claibornica* is *Fusinus nexilis* Dall, 1890, from the Miocene Tampa Silex beds at Ballast Point, Tampa Bay, Florida. This occurrence of *Fusinus* s.s in the Eocene of North America is interesting, as it places the earliest American representative at a similar time to the earliest European ones, found in the Eocene of the London, Hampshire, and Paris Basins. Most European representatives are closer to the type species of the genus, *Fusinus colus* (Linnaeus, 1758), with its very slender shape and extremely long canal than are the American species. One European species that appears more related to the American ones is *Fusus valenciennesii* (Grateloup, 1840), from the Miocene of Bordeaux, France.

Etymology.—Noting the first Claibornian representative of *Fusinus.*

Type information.—Holotype: PRI 30399; paratype: PRI 30400, a juvenile. Type locality: locality 20. Paratype from locality 4.

Material examined.—14 specimens, the largest complete 50 mm length, 22 mm width. One large incomplete specimen is estimated to have been about 145 mm in length.

Subfamily **PERISTERNIINAE** Tryon, 1881, p. 47

Genus **LATIRUS** Montfort, 1810, p. 531

Type species.—*Latirus aurantiacus* Montfort, 1810, (=*Murex gibbulus* Gmelin, 1791) by original designation. Recent, Australia and Fiji.

Diagnosis.—Shell solid fusiform. Whorls with broad solid collabral costae and overriding spiral lines or ribs. Body whorl greater than half the total length, neck short. Aperture ovate, columella straight with faint folds, canal moderate in length, siphonal fasciole prominent margining an umbilical slit. Outer lip lirate within, basal notch absent.

Remarks.—The prominent siphonal fasciole margining a small umbilicus is not usually present on Claibornian representatives of *Latirus* s.s. except on mature and gerontic individuals. Only on *Latirus moorei* Gabb, 1860 has it been noted as a well developed feature. The genus is very common in the Paleogene of the Gulf and Atlantic coastal plains, 37 species having been reported. The genus is known from the Upper Cretaceous to Recent.

Subgenus **POLYGONA** Schumacher, 1817, p. 241

Type species.—*Polygona fusiformis* Schumacher, 1817, by original designation. Recent, Florida and the West Indies.

Diagnosis.—Protoconch conical, nucleus squat. Shell slender, whorls carinate and ramped. Aperture long and narrow, posterior channel formed by the parietal ridge, constricted below to a slightly emarginate canal. Siphonal fasciole high and narrow, columella with three folds.

Remarks.—Most of the Claibornian and Jacksonian species of *Latirus* are probably referable to this subgenus. The subgenus is known from the Upper Cretaceous to Recent.

Latirus (Polygona) traceyi, new species
Plate 16, figures 3–4

Description.—Shell small, solid. Whorls nine, protoconch smooth and conical, of about four whorls, the final half turn with fine arcuate riblets, nucleus swollen. Whorls convex, ornamented with seven nodular costae per whorl and three prominent spiral lines causing the whorls to be tricarinate. The uppermost spiral is very weak on early whorls but slowly increases in

strength to become equal to the other two. The interstices between the main spirals with fine lines of many sizes ranging down to the microscopic, the interstice between the suture and uppermost spiral with two to four larger lines. Body whorl with 11 larger spiral lines and many small ones that decrease in strength towards the base. Aperture ovate, outer lip strongly lirate within, edge fluted by the large spiral lines, gutter formed by a thick deposit of callus. Columella straight with three weak folds, canal moderate in size, bent and twisted, siphonal fasciole weak, umbilicus a chink or absent.

Remarks.—Two species are quite closely related: *Latirus sexcostatus* Johnson, 1899, from the Landrum Member of the Cook Mountain Formation and *Latirus (Polygona) vokesae* Allen, 1970, from the Saline Bayou Member of the Cook Mountain Formation in Louisiana. *Latirus (P.) traceyi* is distinguished from *L. (P.) vokesae* by the protoconch possessing only half a turn of riblets rather than two turns, a stronger spiral sculpture and slenderer profile. *Latirus sexcostatus* has six costae per whorl, only two prominent spiral lines, a smooth and shining surface and generally more subdued spiral sculpture.

Etymology.—The species is named in honor of Steve Tracey, a worker on the English Tertiary Mollusca, for the many productive discussions and for the loan of much English material.

Type information.—Holotype: PRI 30401; paratype: PRI 30402. Type locality: locality 4.

Material examined.—Eight specimens, the largest 13.0 mm length.

Genus **TEREBRIFUSUS** Conrad, 1865a, p. 28

Type species.—Buccinum amoenum Conrad, 1833b, by monotypy. Claibornian Eocene of the United States.

Diagnosis.—Shell small to medium, fusiform, spire high, somewhat coeleoconoid. Protoconch whorls smooth, rounded. Whorls convex, with prominent longitudinal costae and spiral lines, sutures impressed. Body whorl large, aperture long, posterior gutter, canal short and deeply notched, siphonal fasciole present. Columella straight, with numerous folds, inner lip smooth.

Remarks.—The genus is restricted to the Eocene of North America.

Terebrifusus multiplicatus (H. C. Lea, 1841)
Plate 16, figures 11–12

Terebra multiplicata H. C. Lea, 1841, p. 101, pl. 1, fig. 19; 1849, p. 106; Harris, 1895c, p. 29; Pace 1902, p. 110.
Mitra (Terebrifusus) multiplicatus (H. C. Lea). de Gregorio, 1890, p. 77, pl. 5, fig. 65 copy H. C. Lea.
Terebrifusus multiplicatus (H. C. Lea). Palmer, 1937, p. 308, pl. 53, figs. 3, 8, 11, 14; pl. 88, fig. 4 type; Brann and Kent, 1960, p. 854; Palmer and Brann, 1966, p. 950; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 18, 33.

Remarks.—The Reklaw specimen is slightly slenderer that the later Claibornian specimens and shows the fine intermediate spiral lines between the major ones on the later whorls that is characteristic of *T. multiplicatus.* The major difference distinguishing the Reklaw species is the almost complete absence of the columellar plications, their place being taken by denticle-like swellings at the edge of the columella. Examination of numerous specimens of the species from the Lower Claiborne shows the strength of the plicae to be quite variable; specimens range with columellar plications that are almost absent to those that are very prominent.

Type information.—Lectotype: ANSP 13160. Type locality: Claiborne Bluff, Alabama River, Alabama. Figured Reklaw specimen: PRI 30539, from location 20.

Material examined.—One specimen, 8.2 mm length.

Genus **MAZZALINA** Conrad, 1860, p. 295

Type species.—Mazzalina pyrula Conrad, 1860, by monotypy. Eocene, United States.

Diagnosis.—Shell small to large, inflated and usually short. Whorls flat or concave-convex, carinated below the suture, surface smooth or with fine spiral lines, stronger basally. Body whorl very large and inflated with a somewhat twisted canal and small siphonal fasciole. Aperture pear-shaped, notched above and constricted below at the start of a moderately long wide canal that is bent to the left. Outer lip thin, prosocline, inside smooth or plicate. Columella strongly concave above, smooth or with folds, below bent to the left.

Remarks.—The genus is close to *Bulbifusus* Conrad, 1865a, but Harris (1894, p. 165–166) shows that the two genera are probably synonymous on the basis of a large collection from the Eocene of Arkansas. Wenz (1944) reports the genus as ranging from the Upper Cretaceous to the Eocene and probably also the Miocene. Cossmann (1901a, p. 52), placing a rather wider interpretation on the genus, has it ranging to the Recent in the Philippines.

Mazzalina conica, new species
Plate 16, figures 5–6

Description.—Shell medium in size, spire short and cyrtoconoid. Whorls five (nuclear whorls not known), convex, carinate, with a prominent ramp that progressively increases in size and angle, suture channeled. Early whorls tuberculated below the carina, later ones lose the vertical ornament and possess spiral lines that increase in size with growth. Body whorl very large

and smooth, base with prominent spiral lines. Aperture ovate, notched above, outer lip lirate within, columella smooth, excavated, canal short, reflected and slightly emarginate.

Remarks.—The cyrtoconoid profile, convex whorls and prominent carina on the spire whorls can immediately distinguish this species from *Mazzalina inurata* (Conrad, 1833a). This species is also no closer to the Sabinian Stage representative *Mazzalina plena* (Aldrich, 1886), a species that Harris (1899) regarded as a slight variation from the Claiborne and Jackson forms.

Etymology.—The name *conica* (Latin, cone), refers to the shape of the spire.

Type information.—Holotype: PRI 30403. Type locality: locality 14.

Material examined.—Two specimens, the largest 17.0 mm length, 11 mm width.

Genus **SURCULITES** Conrad, 1865d, p. 213

Type species.—Surculites annosa Conrad, 1865d, by original designation. Eocene, Shark River Formation, Shark River, New Jersey.

Original diagnosis.—"Turrited, spire elongated; whorls angulated above the middle, with an impressed revolving line above the suture; whole surface marked with fine, revolving, wrinkled lines, becoming large and distinct towards the base." (Conrad, 1865d, p. 213)

Remarks.—Prior to Glibert (1938, p. 99) who placed *Surculites* in the Galeodidae, the genus had always been assigned in the Turridae. Wrigley (1939, pp. 281–283), after an analysis, concluded that the earlier assignment of *Surculites* to the Turridae was incorrect, and that the genus probably should be placed somewhere between the families Fusinidae and Buccinidae. Powell (1966) agreed with Wrigley's analysis. Wenz (1943), Gardner (1945), Korobkov (1954), Palmer and Brann (1966), and Squires (1987), have continued to place the genus under the Turridae. I find Wrigley's argument convincing and follow his and Powell's assignment. The genus *Surculites,* is confined to the Eocene of Europe and North America.

Surculites lapillus, new species
Plate 16, figures 7–8

Description.—Shell large for the genus, fusiform and with a conical spire. Whorls eight and a half to nine, protoconch of two and a half to three smooth whorls, rapidly increasing in size. Adult sculpture with a broad rounded keel, a concave shoulder which is produced into a vertical flange and which borders the strongly channeled suture. Spire whorls concave below the shoulder which causes a slight carination to become apparent by the body whorl. Adult ornament of crowded spiral and longitudinal lines, the spiral lines alternating in size above the shoulder, stronger below it. The weaker spiral lines have a tendency to be duplex in character, the space between the lines covered with collabral lines, the intersections with the spiral lines forming nodes and having a strikingly tessellated appearance. Aperture elongate-triangular, notched posteriorly. Inner lip with a weak anterior callus deposit, canal long and obscurely twisted anti-clockwise, anterior notch shallow. The genus is known from the Eocene through the Miocene.

Remarks.—This is a very distinctive species whose closest analog seems to be *Surculites cabezi* Gardner, 1945 from the Weches Formation of Texas and the Laredo Formation of Mexico. The present species is distinguished by its more elongate form, the rounded shoulder and finely beaded ornamentation.

Etymology.—The specific name *lapillus* (Latin, bead), refers to the beaded surface of the whorls at the intersections of the lines.

Type information.—Holotype: PRI 30406; paratype: PRI 30407, a juvenile. Type locality: locality 20.

Material examined.—Five specimens, two large ones (the holotype 33.0 mm length), 15.0 mm width, one juvenile with a perfectly preserved protoconch and two fragments.

Genus **CLAVILITHES** Swainson, 1840, p. 77

Type species.—Clavilithes longchaeus Lamarck, 1803, by subsequent designation (Grabau, 1904, p. 105). Eocene of England and France.

Original diagnosis.—"Unequally fusiform, the body whorl and spire being conic, and the canal suddenly contracted and attenuated; terminal whorls papillary; inner lip thick; pillar smooth" (Swainson, 1840, p. 304).

Remarks.—Clavilithes is rather uncommon in the Stone City and Cook Mountain Formations of East Texas, its place seemingly taken by the closely similar genus *Papillina* Conrad, 1855. *Papillina* can be distinguished from *Clavilithes* by its spinose periphery and higher multispiral protoconch. The genus is known from the Paleocene to Pliocene.

Clavilithes parvetorbis, new species
Plate 17, figures 1–2

Description.—Shell fusiform, spire coeloconoidal, whorls 12 in adult, first one or possibly two nuclear whorls missing from all available material. First extant whorl smooth and rounded, the next one with riblets that are crossed after a quarter of a whorl by seven spiral lines. The next six whorls have about seven rounded longitudinal folds per whorl, concave above

spiral lines. By the eighth whorl the folds have become obsolete and later whorls have smooth and almost vertical sides. Sutures deeply impressed, shoulder prominent and margined below by an impressed spiral line, the remainder of the spire whorls with faint to obsolescent spirals. Body whorl bicarinate, beak long and straight, columella moderately excavated. Aperture long, elliptical and with a prominent channel which is margined below with a strong line; a prominent notch is formed where this line meets the suture. Area below the body whorl carination with five spiral lines to the end of the beak.

Remarks.—This species has close affinities with *Clavilithes texanus* Harris, 1895a. That latter species has a straight-sided spire with more subdued spiral lines, a prominent rounded carina, and a well-defined subsutural excavation. The species bears a remarkable resemblance to several European species, in particular to *Clavilithes scalaris* (Lamarck, 1816). From the illustrations alone, the greatest resemblance might be to *C. scalaris,* but a hand comparison with specimens of *Clavilithes britannicus* Wrigley, 1927 from the Barton beds of England shows that species to be a closer match. On the Reklaw specimens the sutures are more deeply channeled, and have a slightly less acute angle; otherwise the specimens are practically indistinguishable. The author hesitates, however, to describe this as a species or subspecies of a European form without further study and more material, especially of a form such as *Clavilithes* which has relatively few distinguishing morphological characteristics. It is therefore named as a distinct species here.

Etymology.—The specific name *par* (Latin, like) *vetorbis* (latin, old world), refers to the close resemblance to many old world species of *Clavilithes.*

Type information.—Holotype: PRI 30408; paratype: PRI 30409, a juvenile. Type locality: locality 21.

Material examined.—28 specimens, the largest essentially complete: 87.0 mm length, 30.0 mm width. One large broken specimen is estimated to have been 120 mm in length.

Clavilithes? acus, new species
Plate 16, figures 13–14

Description.—Whorls 13, protoconch multispiral, smooth, narrowly conical of five whorls; transition to teleoconch marked by a strong varix. Teleoconch whorls margined by a swollen collar, constricted below, coarsely vertically nodular with seven nodules on early whorls, ten on the body whorl, the nodules becoming obsolete towards the subsutural collar. Surface ornamented by flat spiral bands, stronger and often duplex on later whorls, occasional intermediate weaker lines, all crossed by minutely scabrous growth lines which form a shallow "turrid-like" notch over the rounded carina. Aperture long, columella long and straight with a thick, smooth callus deposit.

Remarks.—This is a puzzling species which in the early teleoconch stage resembles *Clavilithes kennedyanus* Harris, 1895a, from the Weches Formation, but lacks the mammillated protoconch of that and other species of *Clavilithes.* The multispiral conical protoconch also precludes an assignment to *Fusinus* Rafinesque, 1815, or *Falsifusus* Grabau, 1904, to which a certain resemblance is also apparent. Harris's (1895a) drawing of *C. kennedyanus* shows a specimen in which the early ribbed stage gives way fairly rapidly to a smooth stage; in my experience that transition is fairly gradual in Weches specimens and *C. kennedyanus* resembles a smooth variant of *C.? acus*; the "turrid-like" growth lines are also apparent on *C. kennedyanus* although to a lesser degree. Despite the similarity to *Clavilithes,* the protoconch is atypical of Clavilithes s.s. and the lower part of the aperture shows no constriction as is also typical in that genus. The aperture and canal in fact are very *Fusinus*-like and *C.? acus* combines characters of the two genera. I can find nothing similar described in the literature.

Etymology.—The name *acus* (Latin, needle), notes that feature of the protoconch.

Type information.—Holotype: PRI 33107. Type locality: locality 4. Paratype: PRI 30398, from locality 20.

Material examined.—Four specimens, three juvenile. The largest (the holotype) 50.4 mm long.

Genus **LEVIFUSUS** Conrad, 1865a, p. 17

Type species.—*Fusus trabeatus* Conrad, 1833a, by subsequent designation (Cossmann, 1901b, p. 14). Eocene of the United States.

Diagnosis.—Shell medium in size to large; protoconch conical, of one and one half to two smooth, conical whorls; teleoconch whorls carinated, the carina with serrations or spines; ramp concave, below the carina cylindrical or weakly inflated; sculpture of fine spiral lines that are stronger on the basal part of the body whorl; axial sculpture weak or absent, sometimes with low folds; body whorl often with a lower serrated keel; aperture oval, smooth, outer lip lirate within; canal long and somewhat twisted.

Remarks.—*Levifusus* ranges from the Paleocene (doubtfully Upper Cretaceous) to the Eocene. It is a common component of the Gulf Coast Paleogene, over 30 species being recognised. The genus has been used in a very wide sense, to include forms such as *Levifusus prepagoda* Palmer, 1937, with its coeloconoidal spire, strong axial sculpture on the early whorls and a

Busycon-like protoconch, and forms such as the strongly spinose *Levifusus spiniger* Conrad, 1848.

Levifusus? serrae, new species
Plate 18, figures 4–5

Description.—Shell small, broadly fusiform, of up to seven and one-quarter whorls. Protoconch conical, of three to three and one half rounded whorls, the first two to two and one half smooth, last one with arcuate riblets. Spire whorls strongly carinate with a serrated keel, the rounded tips of which are the extension of low folds, the folds becoming obsolete above the suture and continuing down to the suture below. On the body whorl the folds continue to the second carina where nodes are formed at the intersections. Suture impressed, shoulder concave with eight to nine strong spiral cords. Below the keel are similar cords, increasing in strength as they approach the anterior canal. Outer lip thin, aperture pyriform; anterior canal long and bent slightly to the left, constricted at its initiation and emarginate towards the base.

Remarks.—With the exception of the protoconch, this species closely resembles the early whorls of *Levifusus spiniger* Conrad, 1848, from the Oligocene of Mississippi. *L. spiniger* has a protoconch of two smooth whorls, weaker spiral lines, and the whorls are lower. This probably indicates all species of *L.? serrae* found so far are juveniles. I am indebted to David Dockery for pointing out the relationship to *L. spiniger*. Confusingly, this species appears close to several turrids, in particular *Clinura calliope* (Brocchi, 1814) (*cf.* Pinna and Spezia, 1978, pl. 31, figs. 2, 2a), a species from the Neogene of Crete. This species is, however, much larger, and *Clinura* Bellardi, 1875, has a polygyrate, narrowly conical protoconch, the later whorls cancellate, a smooth shoulder area, and a sinus with the apex very near to the suture. The type of protoconch seen in *L.? serrae* is also exhibited in several other turrid genera, for instance the New Zealand genus *Tahusyrinx* Powell, 1942. I have doubtfully assigned the species to *Levifusus*, as the protoconch is unlike any other *Levifusus* species I am aware of.

Etymology.—The specific name *serrae* (Latin, saw), refers to the saw-tooth character of the keel.

Type information.—Holotype: PRI 30467; paratypes: PRI 30468, 30469. Type locality: locality 20.

Material examined.—21 specimens, the largest: 10.5 mm length, 5.4 mm width.

Family **MELONGENIDAE** Gill, 1867, p. 145
Subfamily **MELONGENINAE** Gill, 1867, p. 145
Genus **CORNULINA** Conrad, 1853a, p. 321

Type species.—*Cornulina armigera* Conrad, 1833a, by subsequent designation (Fisher, 1884, p. 621). Eocene of the Paris Basin and England.

Diagnosis.—Shell short-fusiform to globose, with two rows of spines on the body whorl; columella rounded; siphonal fasciole prominent and ridged; canal strongly bent to the left; labrum with three teeth, two of them very small.

Remarks.—*Cornulina* is restricted to the Eocene of the Americas, Africa and Europe.

Cornulina minax dockeryi, new subspecies
Plate 17, figures 3–6

Description.—Shell medium sized to large, heavy; spire short, most of the ornamentation covered with a thin coat of callus; body whorl short, the upper and lower carinae with a row of short spines, equal-sized in the adult, in the juvenile the lower carina is a noded cord; spiral ornamentation weak on the body whorl, stronger below on the base; aperture large, rounded, channeled posteriorly; columella rounded, slightly excavated; siphonal fasciole prominent; canal short and bent to the left.

Remarks.—This Reklaw subspecies is differentiated from *Cornulina minax* by its lower form, smaller spines, and more subdued spiral ornamentation. The species *Cornulina armigera* (Conrad, 1833a) exhibits few characters that can be used to differentiate the various races in the Sabinian and Claibornian stages in the American Eocene. Typically the Sabinian forms are more spinose and high-spired than the Claibornian forms, particularly in the adult shell. Both forms were originally grouped together under *C. armigera* but Palmer and Brann (1966) split the Sabinian, Cook Mountain Formation and Gosport Sand species, indicating they should be differentiated. The Sabinian species are certainly differentiable for in addition to the characters mentioned above it can be noted that the basal spiral lines evenly decrease in strength anteriorly and the upper row of spines is continued over the midsection of the body whorl as low folds. None of the specimens from the Cook Mountain or Gosport Sand formations shows that feature. With regard to the splitting of the Cook Mountain and Gosport Sand specimens I can find no character that can consistently separate them; a large number of individuals from the Stone City Formation exhibit a range of variation that includes those typified by the Gosport Sand form and in fact also approaches closely the Jacksonian species, *Cornulina dalli* (Harris, 1894). Dockery (1980) has separated the Sabinian stock under *Cornulina minax compressa.* This latter species occurs in the Bashi, Nanafalia and Pendleton formations of Alabama, Mississippi and Texas. This species is differentiated primarily by the whorls impinging on the previous row of spines, a strong spiral groove below the lower row of spines and further grooves of decreasing strength

towards the base. I do not believe that the first character can be used in differentiation as it is seen widely throughout the group. The holotype shows low folds continuing below the spines, and that feature together with the basal grooves of decreasing strength, relate it to *Cornulina minax* (Solander, 1776), rather than *C. armigera.* The compressed form and other characters, however, do warrant its separation as a distinct subspecies of *C. minax.* The adult Reklaw specimens are rather worn but can still be assigned under *C. minax.* The juvenile specimens, one of them perfectly preserved, are very different from the juveniles of the Cook Mountain and Gosport Sand formations and show the folds under the row of spines very well. The juveniles of *C. armigera* and its subspecies all lack the lower row of spines, a character developed in the adult form. The European species *C. minax* is a high-spired species that has a slight subsutural swelling at all stages of growth but does not have the later whorls encroaching on the earlier ones. The differences between the species are more apparent in the juveniles, the profile approaches that of a spinose *Cornulina dalli cetavia* Palmer, 1947, rather than one of the *C. armigera* varieties. Juveniles of *C. minax* from the Bracklesham beds of England are very close to juvenile Reklaw specimens of *C. minax dockeryi* with the exception of the coarser basal lines of *C. minax.*

Etymology.—In honor of David Dockery of the Mississippi Bureau of Geology.

Type information.—Holotype: PRI 30411, from locality 4.

Material examined.—Eight specimens, the largest 40 mm length, 30 mm maximum diameter.

Genus **SYCOSTOMA** Cox, 1931, p. 291

Type species.—Fusus bulbiformis Lamarck, 1803, by original designation. Eocene of the Paris Basin and England. Cox (1931) replaced *Sycum* by *Sycostoma. Sycum* Bayle, 1880, is itself a new name for *Leiostoma* Swainson, 1840, the original diagnosis of which is given below.

Original diagnosis.—"Equally fusiform, but ventricose in the middle; shell entirely smooth, almost polished; inner lip thickened and vitreous; base of the pillar very straight. Fossil only." (Swainson, 1840, p. 308)

Remarks.—The genus is known from the Upper Cretaceous to the Oligocene.

Sycostoma texana, new species
Plate 17, figures 13–14

Description.—Shell medium in size, spire coeloconoid, whorls nine, shouldered, the shoulder profile level on the spire, becoming a shallow depression by the body whorl. Suture impressed and with impressions of four or five spiral lines below it. Body whorl large, inflated, and with a few spiral lines on the base which curve into a weak siphonal fasciole. Aperture oval-elongate, outer lip smooth within except for a few widely spaced impressed striae in the upper half. Columellar lip smooth with a coating of callus and with a slight anterior swelling which leads into a short slightly recurved canal.

Remarks.—The only other species referred to this genus in the Eocene of the Gulf and Atlantic coastal plains is *Sycostoma americanae* Palmer, 1937, from the Lisbon Formation of Alabama; that species has a greatly enlarged body whorl and has a prominent shoulder. The common species *Neptunea enterogramma* Gabb, 1869, which Palmer (1937, p. 323–324) also assigned to *Sycostoma,* is now assigned to *Bolis* Gardner, 1939. This latter genus can be distinguished by the straight-sided adult whorls, the channeled suture and more prominent callus.The Reklaw species is closer to the Paris Basin species *Sycostoma pyrus bulbiformis* Lamarck, 1803, and can be distinguished from it by the expanded body whorl and the impressed suture.

Etymology.—Noting the first discovery of the genus in Texas.

Type information.—Holotype: PRI 30414. Type locality: locality 20.

Material examined.—One specimen, 30.0 mm length, 16.0 mm width.

Genus **MICHELA** Gardner, 1945, p. 230

Type species.—Levifusus trabeatoides Harris, 1895a, by original designation. Lower Claiborne of the western Gulf province.

Original diagnosis.—"Protoconch of three smooth and two sculptured whorls, . . . [initial turn] for the most part submerged. Spiral sculpture introduced from the beginning of the fourth whorl; posterior spiral outlining the shoulder . . . Spire terraced, the shoulder a steep ramp . . . axial sculpture confined in the genotype to the earlier whorls; entire surface of conch spirally lirate . . . Outer lip flaring, . . . strongly and closely wrinkled within, from the commissure to the entrance of the anterior canal . . . Anterior canal of moderate length, twisted backward slightly and nasute at its extremity . . . pillar not plicate . . ." (modified after Gardner, 1945, p. 230).

Remarks.—Gardner essentially distinguishes this genus from the very closely allied *Levifusus,* by the larger protoconch of one less turn, the wrinkled inner lip and the absence of a fold on the columella. Powell (1966, p. 145) considered the original placement in the Turridae to be incorrect for much the same reasons that

Wrigley (1939, pp. 281–283) transferred *Surculites* from the Turridae. The genus is restricted to the Eocene.

Michela trabeatoides carinata, new subspecies
Plate 17, figures 15–17

Description.—Whorls six, shoulder smooth or with only faint spiral striae on the early whorls of the spire, later whorls with prominent spiral lines. Spire whorls carinate, the periphery crenulated, with two to three larger lines crowding the carina and crossed by longitudinal folds which run from the uppermost line to the lower suture, retral sinus in the lower third of the shoulder. Suture more deeply impressed than in *Michela trabeatoides* (Harris, 1895a). Body whorl tricarinate, the lowest one faint and rounded. Labrum smooth within; canal longer than in the type and somewhat twisted.

Remarks.—This variety is larger than *Michela trabeatoides* (Harris, 1895a) s.s. that ranges from the Weches through the Cook Mountain formations; the Reklaw form keeps the carination on the body whorl. One large fragment of this species shows no trace of crenules on the body whorl, is strongly bicarinate and covered with spiral lines alternating in size.

Etymology: The name *carinata* (Latin, keeled), refers to the prominent carinated keel on this species.

Type information.—Holotype: PRI 30327; paratype: PRI 30416. Type locality: locality 18.

Material examined.—26 specimens, the largest 30.0 mm length, 17.0 mm width. One large fragment measured ca. 42 mm in width.

Genus **STREPSIDURA** Swainson, 1840, p. 90, 308

Type species.—Strepsidura costata Swainson, 1840, by original designation. Eocene of England, France and Belgium.

Original diagnosis.—"Equally fusiform, but the basal portion of the pillar turned inwardly, with a sharp fold at the base of the aperture; shell costated and subcoronated; body whorl ventricose." (Swainson, 1840, p. 308)

Remarks.—The genus is known from the Eocene to Oligocene.

Strepsidura harrisi Givens and Garvie, 1994

?Bulbifusus inuratus Conrad. Heilprin, 1891, p. 396 in part (not *Fusus inuratus* Conrad, 1833a, p. 291).

Strepsidura ficus (Gabb). Harris, 1895a, p. 71, pl. 7, fig. 1; Aldrich, 1895, p. 64, pl. 3, figs. 1, 1a.

?Strepsidura ficus (Gabb). Palmer, 1937, p. 368, pl. 47, fig. 4 (copy pl. 7, fig. 1 in Harris, 1895a).

Strepsidura ficus? (Gabb) or subsp. Palmer and Brann, 1966, p. 922–923 (not *Whitneya ficus* Gabb, 1864, pp. 104, 224, fig. 216).

Strepsidura harrisi Givens and Garvie, 1994, pp. 6–10, pl. 1, figs. 1–6.

Original description.—"Shell of medium size, thin-walled, pyriform, with nearly conical spire about one-sixth the total height of the shell and roundly inflated body whorl; whorls about six, including at least four teleoconch whorls, separated by abutting sutures that are slightly sinuous around costae; spire whorls angulate, with uniformly sloping to slightly concave ramp, sculptured by narrow costae overridden by weaker spiral cords; spiral cord midway between sutures enlarged to form shoulder carina, which is noded at intersections with costae; two enlarged cords at posterior margin of whorl form the subsutural collar, which is minutely noded where crossed by costae; costae and shoulder suppressed on side of body whorl but retained on ramp area and neck; growth line profile nearly straight and vertical on side of body whorl, slightly prosocline on ramp area, aperture elongate-oval, sharply constricted anteriorly to form siphonal canal and gradually narrowed posteriorly to form exhalent channel, outer lip thin and smooth within; inner lip with moderately thick parietal and columella callus, which is sharply limited abapically; columella with prominent fold at start of siphonal canal; a second much weaker and apparently vestigial fold is sometimes present posterior to the prominent fold, siphonal canal moderately long, twisted, oblique, deeply notched; siphonal fasciole strong, limited posteriorly by a sharp keel." (Givens and Garvie, 1994, pp. 6–10)

Remarks.—Similar forms occur in the Tejon Eocene of California, in particular from Grapevine Canyon. The Californian forms tend to be a little broader, are slightly more excavated on the shoulder and have weaker ribs. Palmer and Brann (1965, p. 922–923) conjectured that the Californian and Texas species might be conspecific; Givens and Garvie (1994), showed this not to be the case. A very similar species of *Strepsidura* has been found in the Queen City Formation on the Colorado River, Bastrop County, Texas and is now lost. There is also an undescribed species of *Strepsidura* that I have found in the Seguin Formation in Texas.

Type information.—Holotype: UT-TMM 939TX1; paratype: PRI 33114. Type locality: locality 20.

Material examined.—11 specimens, the largest 20.0 mm length, 12.5 mm width.

Family **BUCCINIDAE** Rafinesque, 1815, p. 145

Genus **LAEVIBUCCINUM** Conrad, 1865a, p. 21

Type species.—Buccinum prorsum Conrad, 1833b, by monotypy. Eocene, upper Claiborne Group, United States.

Diagnosis.—Protoconch smooth, multispiral with

depressed nucleus. Whorls rapidly enlarging, convex, suture deeply impressed. Sculpture of regularly spaced spiral lines. Body whorl large, more than half the total length with short spirally lirate base. Aperture elongate, somewhat emarginate anteriorly, basal notch wide and shallow. Labral profile parasigmoidal, somewhat thickened and lirate. Columella smooth, concave and slightly twisted.

Remarks.—Five species of *Laevibuccinum* are known from the Eocene of the Gulf and Atlantic coastal plains. The genus is restricted to the Paleocene and Eocene of North America.

Laevibuccinum lineatum Heilprin, 1881
Plate 17, figures 7–8

Laevibuccinum lineatum Heilprin, 1881, p. 371, pl. 20, fig. 5. Harris; 1896, p. 97, pl. 9, fig. 15; 1899, p. 52, pl. 6, fig. 12; Palmer, 1937, pl. 44, fig. 3, 4.

Original Description.—"Shell fusiform, of about seven convex volutions which are throughout their whole extent covered by fine but distinct revolving lines; aperture slightly exceeding the spire in length, subcaniculate anteriorly; columella greatly arcuate; outer lip striate within." (Heilprin, 1881, p. 371)

Remarks.—This species ranges from the Midwayan to the Sabinian stage. The primary difference between *L. lineatum* and the type *L. prorsum,* is that the latter has a smooth body whorl midsection. It is interesting that *L. lineatum* is now known to range into the lowest Claiborne strata with no observable change in character.

Type information.—Holotype lost. Lectotype and remaining specimens: ANSP 30554. Type locality: Claiborne Bluff, Alabama River, Alabama. Figured Reklaw specimen: PRI 30412, from locality 4.

Material examined.—114 specimens, the largest: 20.0 mm length, 7.6 mm width.

Genus **EURYOCHETUS** Cossmann, 1896a, p. 35

Type species.—Buccinum cylindraceum Deshayes, 1865. Eocene of the Paris Basin.

Diagnosis.—Shell small, thin-shelled, elongate, whorls convex. Protoconch bulbous, multispiral, and not deviated. Whorls convex, fairly rapidly expanding and covered with fine impressed spiral lines. Suture deeply impressed, body whorl very large, about half the length of the shell. Aperture narrow, ending in a short, hardly constricted, truncated canal. Outer lip thin, slightly parasigmoidal, interior smooth. Columella smooth, almost straight with a narrow channel between two weak folds.

Remarks.—This is an uncommon genus which is restricted to the Eocene of Europe and North America. Palmer in Palmer and Brann (1966) doubtfully recognized one species *Laevibuccinum (Euryochetus?) harrisi* (Aldrich, 1897) from Woods Bluff, Hatchetigbee Formation of Alabama, where Aldrich reported it as common. Palmer regarded it as a subgenus of *Laevibuccinum* Conrad, 1865a, but I prefer to give it full generic status following Cossmann and Wenz. *E. punctatum* is easily distinguished from the somewhat similar shaped *Laevibuccinum lineatum* Garvie, n.sp., by the more acute spire, the high multispiral protoconch, the punctate character of the spiral lines, and the obsolete, hardly constricted canal. The genus is restricted to the Eocene of Europe and North America.

Euryochetus punctatum, new species
Plate 16, figures 1–2

Description.—Shell medium in size, slender. Whorls ten, protoconch conical of four and a half whorls, the transition to the adult marked by a low varix. Early whorls rounded, later ones tending to flatten out below the suture. Surface of spire covered with spiral lines, coarse below the suture, punctate and *Acteon*-like over the remainder. The entire surface finely polished and almost glazed. Base of body whorl with large flat-topped spirals. Aperture elongate, notched, outer lip sharp and expanded, edge thickened within and possessing weak posterior lirae. Columella concave, with one very low swelling on the midsection and a weaker one below an almost indistinguishable channel. Anterior canal very short and slightly twisted, basal notch small and shallow.

Remarks.—This shell was very difficult to place and but for the protoconch would have been placed under *Parvisipho* Cossmann, 1889. That genus, which Cossmann includes under his family Chrysodismidae, is part of a group of buccinids with protoconchs having a papillate, deviated nucleus. One other characteristic of *Euryochetus* is the channel between two columellar folds; that character is seen very weakly in *E. punctatum.* So far as I can determine only one other buccinid genus has punctate spiral lines and that is the deep water genus *Charitodoron* Tomlin, 1932, off the coast of South Africa. The main feature distinguishing that genus is the proportionately smaller aperture.

Etymology.—Referring to the ornament of punctate spiral lines.

Type information.—Holotype: PRI 30413. Type locality: locality 4.

Material examined.—One specimen, 23.0 mm length, 8.3 mm width.

Subfamily **PSEUDOLIVINAE** Swainson, 1840, p. 82

Genus **PSEUDOLIVA** Swainson, 1840, p. 82

Type species.—Buccinum plumbeum Dillwyn, 1817, by original designation. Recent off the coast of West Africa.

Original Diagnosis.—"Shell thick, oval, oliviform, ventricose; spire very short; base with two parallel grooves, one of which forms a notch at the base of the outer lip; suture slightly channeled; inner lip very thick, and turning inwards; aperture with an internal canal. Connects the Turbinellidae with the Volutidae." (Swainson, 1840, p. 306)

Remarks.—The genus ranges from the Upper Cretaceous to Recent, where is is known by one species from West Africa today.

Pseudoliva cf. **santander** Gardner, 1945
Plate 18, figures 1–3

Pseudoliva santander Gardner, 1945, pp. 195–196, pl. 22, fig. 24; Dockery, 1980, p. 104–105, pl. 3 figs. 1A, 1B, 2, 3A, 3B.

Original description.—"Shell large, rudely conic, the outline obscured by excess callus. Early whorls lost, and characters of adolescent largely concealed by the enveloping body, but probably similar in a general way to that of *P. vetusta* (Conrad). Body relatively large, heavy, broadly inflated, shouldered in the adult; callus thick, deposited along the suture of the final whorl, overtopping the spire in many individuals. Sculpture other than incremental, obsolete or undeveloped even on the area in front of the pseudoliva groove. Aperture relatively short and narrow, obliquely elliptical. Callus pad at posterior commissure thickly spread from the suture to the groove, distorting the posterior portion of the body and the outer lip; a narrow and fairly deep channel between the pad and the labral margin. Pseudolivar groove narrow and deep. Anterior fasciole corrugated by the growth lines, broadly U-shaped terminally. Umbilicus keeled at the margin apparently closed by the reverted callus." (Gardner, 1945, pp. 195–196)

Remarks.—The Reklaw specimens are not as strongly shouldered as in typical *P. santander,* a species from the lower and middle horizon of the Laredo Formation of Mexico, but agree well in the remaining characters. In particular, in the heavy deposit of callus, the oblique elliptical apertural shape, the keeled margin to the umbilical depression, the distinct channel between the outer lip and the labral margin, these specimens match Gardner's species. Of the various races of *Pseudoliva vetusta,* perhaps the Lower Eocene, Woods Bluff and Middle Eocene specimens from the Weches Formation of 14.4 km. E. of Jewett, Leon County, Texas, approach these most closely. With such a variable form the exact placement is to some degree arbitrary, but after examining an extensive suite of material, *P. santander* appears the closest species. Gardner (1934) conjectured that *P. santander* has an umbilicus closed by the callus, but even on the smallest specimens which have very little callus deposit the umbilicus is absent; in any case that feature has not been taken to be of much value in separating the varieties of *P. vetusta.* The best specimen, a juvenile, shows fine ribbing on the first three adult whorls and fine spiral lines on the next whorl. Juvenile and medium-sized specimens have an obliquely compressed form very similar to *Pseudoliva nana* Gardner, 1945. The Reklaw specimens may to some extent be distinguished by their more globose form, by the almost complete effacement of the suture, and by the protractive outer lip. Very similar forms also occur in the Stone City Member of the Cook Mountain Formation, in Rocky Branch Creek, Burleson County, Texas at the base of the formation.

Type information.—Holotype: USNM 497256. Type locality: given as USGS Sta. 13685 (H-9), Los Aldamas, 1.5 km. E. of El Barrio, in San Juan, Nuevo Leon, Mexico (middle part of the Laredo formation). Figured Reklaw specimens: PRI 30418, 30419, from locality 20.

Genus **SIPHONALIA** A. Adams, 1863b, p. 202

Type species.—Buccinum cassidariaeformis Reeve, 1846, by subsequent designation (Cossmann, 1889, p. 149). Recent, seas around Japan.

Diagnosis.—Shell moderate to large in size, low and inflated. Protoconch small and inclined to the axis of the shell. Whorls convex, often ramped and carinate, suture impressed. Sculpture with collabral costae or nodules and fine spiral lines. Body whorl large, the sculpture effervescent towards the base. Siphonal fasciole distinct, canal bent strongly to the left and shallowly notched. Aperture large, ovate, with posterior gutter, outer lip thin, lirate within; columella smooth and excavated.

Remarks.—Wenz (1944) reports the genus widely distributed but with few species. In the Paleogene of the Gulf coastal plain ten species have been described; the genus is also common in the early Tertiary of the Pacific coast. Several species listed by Palmer and Brann (1966) under "*Siphonalia*" do not seem to come close to the type, which is a squat, carinate shell with a strongly bent canal. Cossmann (1901a) lists a number of species of quite variable character under the genus, a range that could include the Gulf Coast species assigned to *Siphonalia.* The genus ranges from the Upper Cretaceous to Recent.

Siphonalia cf. **plummeri** Palmer, 1937
Plate 17, figures 9–10

"Siphonalia" plummeri Palmer, 1937, p. 318, pl. 45, figs. 3, 4; Brann and Kent, 1960, p. 800.

Original description.—"Shell small; whorls round-

ed, three or four; nucleus of four or five whorls, first two smooth, minute, last three with conspicuous longitudinal ribs; the sculpture of the post-nuclear whorls begins abruptly with a large longitudinal fold and spiral ribs; the surface of the shell is covered with fine spiral threads, with a finer intervening line; there are thirteen, longitudinal folds on an imperfect adult shell; the holotype has nine longitudinal folds but is an immature shell; short anterior canal; labrum crenate within." (Palmer, 1937, p. 318)

Remarks.—The holotype of *S. cf. plummeri* is a juvenile of 7 mm length and 4 mm width and gives a misleading impression of the adult form of the shell; Palmer, (1937, p. 318) notes one of the paratypes has a height of 21 mm. Palmer's species is from the Weches Formation of Texas. The Reklaw species differs from *S. cf. plummeri* in the following minor characters; possessing about one more fold per whorl, being slenderer, and usually lacking the fine intermediate line between the primary spiral lines. These differences seem relatively minor and more material will have to be collected before it is known whether these differences are constant.

Type information.—Holotype: PRI 3092. Type locality: Colorado River at Smithville, Bastrop County, Texas. Figured Reklaw specimen: PRI 30420, from locality 20.

Superfamily **VOLUTOIDEA** Rafinesque, 1815, p. 19

Family **VOLUTIDAE**, Fleming, 1822, p. 490

Subfamily **ATHLETINAE** Pilsbry and Olsson, 1954, p. 15

Genus **VOLUTOCORBIS** Dall, 1890, p. 75

Type species.—Volutilithes limopsis Conrad, 1860, by original designation. Paleocene, Porter's Creek Formation of Alabama.

Diagnosis.—Shell resembling *Volutilithes,* but more slender and without a coronated shoulder; the sculpture is reticulate, and nodose or prickly at the intersections; the sutural sinus is less evident than in *Volutilithes,* and the suture is sometimes channeled.

Remarks.—According to Rehder (1969) the genus ranges from the Paleocene to Recent. Four members of the species are recognized today, all from deep water off the South African coast. Specimens of *Volutocorbis* are generally uncommon in fossil deposits, except paradoxically in the Reklaw, where they are abundant.

Volutocorbis stenzeli (Plummer, 1933)
Plate 18, figures 14–15

Plejonia (Volutocorbis) stenzeli Plummer, 1933, p. 813, pl. 9, figs. 12, 13.

Volutocorbis stenzeli Plummer. Palmer, 1937, p. 384, pl. 59, figs. 1, 2, copies Plummer.

Diagnosis.—First three whorls smooth, next two ribbed, remainder cancellate. 40 longitudinal ribs on the body whorl; transverse ribs about equal in strength to the longitudinal ribs. Apical angle 64°, altitude 20 mm, maximum diameter 10 mm. (After Plummer, 1933, p. 384)

Revised Description.—Whorls seven and a half, protoconch of three and a half smooth whorls, the first minute and almost flush with the next. Adult sculpture starts with two longitudinal costae followed half a whorl later by two transverse ribs at the upper and lower sutures; these are nodular where they cross the longitudinal ribs. At about whorl five a medial fine transverse line develops which rapidly increases in size to become another rib. Later whorls develop further transverse ribs above the lower suture so that the penultimate whorl has four large nodular ribs. Transverse ribs are larger than the longitudinal ones; body whorl crossed by about 23 longitudinal ribs and minute growth lines, two to three columellar folds present, callus visible as a thin wide deposit, outer lip with 13 tubercles.

Remarks.—Some specimens develop the third and fourth longitudinal ribs in the reverse order. Some specimens show a smaller superior columellar fold. Apical angle varies between 60° and 65°. *Volutocorbis limopsis* (Conrad, 1860) has a similar protoconch, equally sized spiral ribs, and vertically flattened tubercles. The longer aperture and straighter spire profile of the Reklaw specimens are very distinctive. The genus persists in Texas until at least the upper Cook Mountain Formation (Landrum and Wheelock members) as the author has a few specimens from Alabama Bluff, Trinity River, and from the Little Brazos River, Texas. *V. stenzeli* has only been found in the Marquez Member in Milam, Bastrop, and Caldwell Counties, Texas.

Type information.—Syntypes: Plummer collection, TBEG P5381, P14165. Type locality: TBEG 28-T-9, dump at the site of old Copper prospect, 4.5 miles NE of Harwood, Caldwell Co., Texas. Figured specimen: PRI 30421, from locality 20.

Material examined.—250+ specimens, the largest: 16.0 mm length, 7.5 mm width.

Genus **ATHLETA** Conrad, 1853b, p. 449

Type species.—Voluta rarispina Lamarck, 1811, by subsequent designation (Dall, 1890, p. 75). Miocene of Europe.

Diagnosis.—Shell fusiform, spire about one-fifth to one-third the height of the shell. Smooth protoconch of one and a half to four and a half whorls followed

by a ribbed stage of a half to a quarter whorl and a cancellate stage between one to one and a half whorls. Teleoconch shouldered, longitudinally costate or ribbed, often spinose at the shoulder; below the shoulder the spiral lines are numerous. Aperture ovate, inner lip with two to three folds, outer lip often denticulate, siphonal canal wide, shallow, slightly recurved, beak long.

Remarks.—The genus is known from the Eocene to Miocene.

Athleta petrosus smithii Fisher and Rodda, 1964
Plate 18, figures 6–9

Athleta petrosus smithii Fisher and Rodda, *in* Fisher, Rodda and Dietrich, 1964, p. 43 +, pl. 8, figs. 8, 9; pl. 11, figs. 1–5
Athleta petrosus smithii Fisher and Rodda. Palmer and Brann, 1966, p. 515–516.

Original description.—"Shell small, medium-sized, whorls eight to ten, protoconch two and seven-eighths to four and a quarter smooth whorls, next quarter to half with longitudinal riblets. Later whorls with a noded shoulder and a noded subsutural ridge, the two separated by a poorly defined ramp. On the larger specimens the shoulder nodes increase in size to become small transversely-pointing spines which are at the termination of low longitudinal folds. Body whorl rounded in small specimens, straight in larger ones, beak sharply constricted into a spirally lirate neck. Aperture straight, obliquely inclined, two columellar folds, slight siphonal fasciole present." (Fisher and Rodda, *in* Fisher, Rodda and Dietrich, 1964, p. 43)

Remarks.—200 specimens were used to measure various characters such as length, spire angle, diameter/length, number of columellar folds, etc. and these noted for each specimen and plotted graphically. Despite the fact that two intermixed species of *Athleta* seemed to be present, no consistent set of characters could be found to reliably separate the groups. The species displays a wider variation of characters than is indicated in Fisher *et al.* (1964); in particular when the number of ribs on the body whorl is plotted against the length, the specimens generally separate into two groups for large specimens and overlap for the smaller ones. The first variety displays the typical profile of *Athleta petrosus* (Conrad, 1833a) s.s. from the Weches through the Gosport Sand formations, with the upward pointing spines, a spire angle of 58°–65° and usually a moderate to heavy amount of callus deposit from whorl seven onwards. The other group tends to have a more subdued profile, a spire angle of 51°–60°, a smaller shoulder ramp, cancellate ornament and missing or weak folds or spines. No consistent set of characters could be found in either the juvenile specimens or the spire of the adult specimens which could consistently distinguish the two groups throughout all stages of growth. In the first group, the adult spinose sculpture may develop in specimens as small as 15 mm and is present in all specimens of 20 mm or larger. About 60% of all specimens have a moderate amount of callus deposit, 20% showing prominent denticles on the outer lip. These characters are not dependent on the growth stage of the specimen, being displayed on specimens as small as 5 mm. For very small specimens of 5–7 mm, or four to five whorls, a separation into two stocks is again apparent; those with a high protoconch of three and a half to four whorls, coarse longitudinal folds and lack of transverse lirae on the body whorl, and those with a more squat protoconch of three and an eighth to three and three-quarters whorls, shoulder rarely present and a more uniform cancellate ornament. The high protoconch group can be correlated with the spinose adult form but only in general terms. It is possible that these specimens contain two species, the descendants of the stocks of *Athleta tuomeyi* Conrad, 1853b from the Paleocene and Lower Eocene, and *Athleta petrosus* (Conrad, 1833a), that have not become sufficiently differentiated to separate them taxonomically. Alternatively this might be a case of sexual dimorphism.

Type information.—Holotype: TBEG 35288. Type locality: bluff on Ridge Creek, 6.2 m. West of Smithville, Bastrop County, Texas; locality 6 (=TBEG locality no. 11-T-7). Figured specimens: PRI 30422–30424, from locations 20.

Material examined.—400+, the largest 34 mm length, 19 mm width, spire angle 57°–73°.

Family **HARPIDAE** Bronn, 1849, p. 469

Genus **CRYPTOCHORDA** Mörch, 1858, p. 43

Type species.—Buccinum stromboides Hermanns, 1781, by monotypy. Eocene of England and France.

Diagnosis.—Shell fusiform, not high, smooth. Protoconch rounded with four smooth whorls. Whorls rounded, body whorl large and inflated, basally constricted to a short neck, siphonal fasciole weak. Aperture elongate with posterior gutter, anterior notch deep. Outer lip thickened, almost straight. Columella without folds, curved several times, anteriorly reaching below the labrum, columellar callus thinly covering the ventral surface and most of the spire.

Remarks.—The genus is relatively rare and restricted to the Paleogene of North America and Europe. Four Claibornian species are known and one from the Eocene of California.

Cryptochorda? sp.
Plate 18, figure 16

Remarks.—Several fragments of the outer lip of a *Cryptochorda* were obtained, all of them associated

with a large mass of worn coral. The differences between this species and other Claibornian ones indicate a less robust species with a thinner spread of enamel. The base of the body whorl has five to seven impressed spiral lines, a feature also seen in some specimens of *Cryptochorda eureia* Stenzel and Turner, 1940, from the Weches Formation of Texas.

Material examined.—Five fragments, the largest 25 mm length, comprising the lip and part of the body whorl, from locality 20. Figured specimen: PRI 33129.

Family **OLIVIDAE** Latrielle, 1825, p. 198

Genus **ANCILLA** Lamarck, 1799, p. 70

Type species.—Voluta ampla Gmelin, 1791, by monotypy. Living in the Indo-Pacific.

Diagnosis.—Shell elongate, ovoid-fusiform; sutures usually externally covered with callus; surface smooth, often polished. Aperture long, broader anteriorly, with a slight anterior notch, outer lip sharp, smooth within; columella slightly twisted, with fine folds; anterior part of the aperture with a callus deposit.

Remarks.—Wenz (1943) lists *Ancilla* ranging questionably from the Cretaceous (Senonian) to recent. The genus is well known, and common in the Sabinian and Claibornian stages of the Gulf coastal plain. The genus s.l. is ranges from the Upper Cretaceous to Recent.

Subgenus **OLIVULA** Conrad, 1832b, p. 25

Type species.—Ancilla (Olivula) staminea (Conrad, 1832b), by subsequent designation (Cossmann, 1899b, p. 70). Sabinian and Claibornian stages of the southeastern United States.

Diagnosis.—Shell medium to large in size; elongate, spire short; suture somewhat channeled; subsutural collar heavy, covered by callus that extends over the upper margin of the preceeding whorl; aperture very long, somewhat expanded anteriorly; outer lip straight or weakly convex, posteriorly abruptly bent towards the body. Ancillid band broad, fasciolar band divided into two bands by a spiral line; fasciolar groove deep.

Remarks.—Olivula is an Eocene genus restricted to North America.

Ancilla (Olivula) staminea reklawensis, new subspecies
Plate 19, figures 15–16

Description.—Shell medium in size, elongate, weakly inflated; spire whorls covered with a thin even coat of callus which spreads from the apertural region to the previous or earlier whorl; collar with a groove on the upper third to one quarter; sculpture of very subdued ornamentation of longitudinal lines and spiral striae.

Remarks.—Lower Eocene forms of *Ancilla (O.) staminea* have a thick development of the callus and only one groove in the anterior enamel band; the body whorl ornamentation is very similar to that of Middle Claibornian forms of *A. (O.) staminea.* The labial development of the Reklaw subspecies is more closely allied to the middle Eocene representatives of *A. (O.) staminea,* which have two grooves on the enamel band, more prominent body whorl ornamentation and a higher and less callus covered spire. Specimens of *A. (O.) staminea* from St. Maurice, Louisiana show the greatest similarity to the Reklaw material.

Etymology.—Referring to the formation.

Type information.—Holotype: PRI 30425; paratype: PRI 30426. Type locality: locality 20.

Material examined.—225 specimens, the largest: 17.4 mm length, 6.2 mm width.

Superfamily **CANCELLARIOIDEA** Gray, 1853, p. 130

Family **CANCELLARIDAE** Forbes and Hanley, 1853, p. 360

Genus **ADMETULA** Cossmann, 1889, p. 224

Type species.—Cancellaria evulsa (Solander, 1776), by original designation. Bartonian Eocene of England.

Diagnosis.—Shell inflated, not umbilicated, with varices and cancellate ornament; protoconch paucispiral, prominent, flattened; aperture oval, outer lip lirate within corresponding to the last varix; beak slighty twisted and bent to the left, not notched; labial deposit thin; columella with three oblique folds, the lowest weaker and not as oblique as the upper two.

Remarks.—The genus is known from the Upper Cretaceous to the Pliocene.

Admetula irregularis, new species
Plate 19, figures 1–2

Description.—Shell small and squat, of five and a half whorls. Protoconch of two and a half smooth rounded whorls, nucleus minute, transition to final adult sculpture is via a cancellate ornament of a quarter whorl. Adult sculpture of 12 to 13 oblique costae which vary irregularly in size from thin raised lines to thick varices, these are overridden by five spiral lines on the spire and 11 or 12 on the body whorl, the intersections with the smaller costae nodular. Whorls strongly contracted at the suture making the sutural diameter less than that of the previous whorl. Aperture ovate, outer lip curving smoothly to the base and lirate within. Columella with plications, the two uppermost stronger and terminating abruptly abaperturally, the lower plication marking the start of a short unnotched canal. Edge of inner lip margining a deep depression.

Remarks.—Two similar species are *Admetula tortiplica* (Conrad, 1865a) and *Admetula parilis* (Palmer, 1937), both from the Middle Claibornian. *A. tortiplica* is more elongate and has one more spiral line on the spire and the columellar plications develop gradually from the two uppermost revolving ribs; *A. parilis* is shorter, has stronger spiral lines and has weaker varices. All the specimens at hand are probably juvenile but are still readily distinguished by the smaller size and irregular ornamentation; the largest specimen (the holotype) has a medial spiral thread between spiral lines on the body whorl. Several similar Cancellaridae from the Claibornian have a similar irregular sculpture but none so pronounced as *A. irregularis.*

Etymology.—Referring to the irregularly sized costae.

Type information.—Holotype: PRI 30427; paratypes: PRI 30428. Type locality: locality 4.

Material examined.—15 specimens, the largest 4.5 mm length, 2.8 mm width.

Genus **TRIGONOSTOMA** Blainville, 1827, p. 652

Type species.—Delphinula trigonostoma Lamarck, 1822, by monotypy. Recent in the Indo-Pacific.

Diagnosis.—Shell globose to high, whorls more or less loosely wound; shoulder wide and concave; aperture trigonal and bent to the right; widely umbilicate, siphonal fasciole strong; columella with two or three plications.

Remarks.—Genus *Trigonostoma* ranges from the Lower Eocene to Recent. Recent species of the genus are temperate to tropical in distribution.

Subgenus **VENTRILIA** Jousseaume, 1887, p. 194

Type species.—Ventrilia ventrilia Jousseaume, 1887 (= *Cancellaria tenera* Philippi, 1848), by monotypy. Recent, in the Caribbean.

Diagnosis.—Whorls carinate, closely coiled, suture channeled or deeply impressed, the diameter less than the carina of the previous whorl; umbilicus well developed, margined by a broad siphonal fasciole; peristome continuous, channeled below; columella concave with two weak folds, partially resorbed at umbilical edge.

Remarks.—Ventrilia is known from the Eocene to Recent.

Trigonostoma (Ventrilia) herbae, new species
Plate 19, figures 3–4

Description.—Shell small, slender for the genus. Protoconch of two and a half smooth whorls, flattened at the apex, nucleus minute, last nuclear whorl greatly expanded. Adult sculpture up to five and a half smooth convex whorls which carry microscopic widely spaced spiral striae, slightly more prominent on the lower part of the whorls. Shoulder prominent, smoothly concave, the keel thickened and with 12 to 14 bladelike costae on each whorl, the upper ends of which are rounded, bent back and projecting well above the shoulder; on the shoulder the upper ends of the costae meet the suture almost tangentially. Aperture ovately triangular, inner lip with two columellar folds that are margined below by a swelling on the columella, labrum with obscure denticles, umbilicus small.

Remarks.—A few specimens have the costae thickened to such a degree that they can be considered varices. The nearest relatives are *Trigonostoma panones* (Harris, 1895a) from the Weches Formation, and *Trigonostoma sabinetownensis* LeBlank, 1942 from the Hatchetigbee Formation. Unfortunately the holotype of *T. sabinetownensis* is lost; based on the published figures and text by LeBlank; *T. sabinetownensis* has sharp costae, is smaller, and has only two columellar folds, while *T. panones* has three columellar folds, thickened costae that are nodular above the keel, and is altogether a broader shell. In *T. (V.) herbae* the costae and growth lines on the shoulder meet almost tangentially while in *T. panones* they meet at ca. 45°. *Trigonostoma gemmatum* (Conrad, 1833a), a more distantly related species, also has the costae meeting the suture almost tangentially. The high spire of this species and lack of strong spiral ornament place this species rather doubtfully in *Ventrilia;* most American Eocene cancellarids require a revison for proper placement but that is outside the scope of this report.

Etymology.—The name *herbae* (Latin, blade), refers to the blade-like costae.

Type information.—Holotype: PRI 30429; paratypes: PRI 30430, 30431. Type locality: locality 20.

Material examined.—92 specimens, the largest: 8.5 mm length.

Trigonostoma (Ventrilia) elegantissima, new species
Plate 19, figures 7–8

Description.—Shell small, slender, of up to six and three-quarter whorls. Protoconch of two and a half to two and three-quarter smooth inflated whorls, nucleus minute. Adult whorls with 17 to 21 strong costae, fluted above and projecting a little above the convex shoulder. About six spiral ribs on the spire and 11 on the body whorl. Sharp prominent nodes are developed where the spiral ribs cross the costae. Aperture triangular, labrum with seven denticles, inner lip with two folds, a denticle on the lower margin and above with two spiral rows of denticles on the callus corresponding in position to the nodes beneath. Length of umbilical area more than half the apertural length.

Remarks.—This species has affinities with *Trigonostoma panones smithvillensis* (Harris, 1895a), *Trigonostoma panones juniperum* (Harris, 1895a) and *Trigonostoma penrosei* (Harris, 1895a), and may be ancestral to all of them. *T. penrosei* also has nodular ribs, but three plications on the columella, 10 to 11 ribs and three spiral lines. Unfortunately the holotype of *T. penrosei* is so damaged that only the published figures can be relied upon. Both *T. harrisi* and *T. juniperum* have an obtuse shoulder angulation, but not as acute as in *T. (V.) elegantissima,* and both have a different apertural profile. The distinctive features of *T. (V.) elegantissima* are the concave profile of the lower portion of the body whorl and the very crisp and nodular ornamentation.

Etymology.—The name *elegantissima* (Latin, most elegant), refers to the very elegant form of this species.

Type information.—Holotype: PRI 30432. Type locality: locality 20.

Material examined.—Nine specimens, the largest: 9.0 mm length.

Trigonostoma (Ventrilia) jonesae, new species
Plate 19, figures 5–6

Description.—Shell small, whorls seven, protoconch of two smooth whorls, the apex flattened and the nucleus depressed and minute. Adult whorls with a rounded shoulder and 14 to 15 costae per whorl of which four per whorl are developed into varices. Whorls crossed by numerous irregularly spaced spiral lines tending to become obsolete above the carina. On the body whorl the ribs are smaller, regularly spaced and crossed at right angles by low undulations on the umbilical margin, the undulations formed by the posterior end of the thickened longitudinal costae. Aperture suboval, labrum thickened within and with seven spiral lirae. Inner lip with two folds and a lower crenulation. Umbilicus small.

Remarks.—The closest relative to this species is *Trigonostoma panones smithvillensis* (Harris, 1895a) from the Weches Formation, but that species has no secondary sculpture, has a more rounded shoulder and keel, and a very much larger protoconch. *T. (V.) jonesae* combines characters common to species of both *Sveltia,* Jousseaume, 1887, and *Trigonostoma. Sveltia alveata* (Conrad, 1833b) from the upper Claiborne Group, of which *T. (V.) jonesae* is a probable ancestor, has a similar shape, protoconch and body whorl ornamentation, but the ornament of the spire is more regular in shape and shows none of the varices characteristic of the Reklaw species. *Trigonostoma* s.s has a channeled suture and a triangular aperture, the base of which is a posterior gutter placed well away from the suture and is reflected to the right. Species of *Sveltia* s.s. have an obliquely elongated aperture, impressed sutures and a flaring outer lip. In *T. (V.) jonesae* the lip is moderately flaring, the base is reflected and an impressed suture is contained within a weak gutter. Most species assigned to *Trigonostoma* in the Claibornian Eocene do not have the base of the aperture reflected to the left, or the channeled sutures typical of that genus.

Etymology.—This species is named in honor of Dr. Carol Jones, formerly of the Academy of Natural Sciences, Philadelphia.

Type information.—Holotype: PRI 30433; paratype: PRI 30434, a juvenile. Type locality: locality 20.

Material examined.—Five specimens, the largest: 10.0 mm length.

Family **MITRIDAE** Swainson,
1831, pls. 49, 50, 54[14]

Subfamily **CYLINDROMITRINAE** Cossmann,
1899, p. 152

Genus **VOLVARIELLA** Fisher, 1883, p. 553

Type species.—*Volvaria lamarcki* Deshayes, 1865, by monotypy. Eocene of the Paris Basin.

Diagnosis.—"Shell small, 7–15 mm, cylindrical and slender, spire short and conical, with almost five whorls; nuclear whorls are smooth and flat. Sculptured with numerous and finely punctate spiral striae. Aperture longer than the spire, straight, slightly flaring anteriorly; columella with 2 anteriorly placed folds." (Cernohorsky, 1970, p. 64).

Remarks.—Cernohorsky (1970), stated that the genus *Volvariella* is probably related to *Cylindites* J. de C. Sowerby, 1824, a genus within the family Acteonidae. As one characteristic of the opisthobranch family Acteonidae is a heterostrophic nucleus, a specimen of *Volvariella milamensis,* n. sp. was carefully broken and the nucleus examined. The nucleus was found to be dextral and in fact quite similar to that of *Ancilla* Lamarck, 1799. On this evidence the genus is kept within the Mitridae where it had been placed by previous authors. The genus is restricted to the Eocene of Europe and North America.

Volvariella milamensis, new species
Plate 19, figures 11–12

Description.—Protoconch of two and a half to three whorls, loosely coiled. Whorls three through six are partially immersed in the later whorls. Body whorl punctate, columella with three folds and above that a swelling that dies out as it revolves into the aperture. The first and third folds continue revolving into the

[14] *Nomen transl.* Adams, A. and Adams, H. 1853 (*ex* Mitranae).

aperture while the second becomes obsolete and merges into the upper one. Spire angle of 77° to 90°.

Remarks.—This species is similar to *Volvariella gabbiana* Harris, 1895a, and could have been assigned there but for the larger number of columellar folds, its spire angle of 115° and its non-punctate surface. Another species related to this one is *Volvariella reticulata* Johnson, 1899; its spire angle is ca. 60°. Two specimens show traces of violet color banding collabral with the growth lines.

Etymology.—The specific name refers to the occurrence in Milam County.

Type information.—Holotype: PRI 30435; paratypes: PRI 30436, 30437. Type locality: locality 20.

Material examined.—17 specimens: the largest 10.0 mm length, 3.0 mm width.

Superfamily **CONOIDEA** Rafinesque, 1815, p. 19

Family **CONIDAE** Rafinesque, 1815, p. 19

Genus **CONUS** Linneaus, 1758, p. 712

Type species.—Conus marmoreus Linneaus, 1758, by subsequent designation (Children, 1823). Recent in the Indo-Pacific.

Diagnosis.—Shell usually solid, thick-shelled, in the form of an inverse cone with straight or concave sides. Spire usually low, later whorls enveloping earlier ones below the suture, ornament above smooth or with rows of nodules, below with spiral lines. Siphonal fasciole strong, smooth or with spiral lines. Aperture thin, elongate, parallel, sometimes a little wider anteriorly, extending most of the length of the shell. Outer lip thin, sharp, top with anal sinus. Columella straight, posterior gutter present, earlier whorls partially resorbed.

Remarks.—Conus s.s. is known from the Pliocene to Recent. The genus is primarily tropical in distribution.

Subgenus **LITHOCONUS** Mörch, 1852, p. 66

Type species.—Conus millepunctatus Lamarck, 1822, by subsequent designation (Cossmann, 1889, p. 232). Recent in the Indo-Pacific.

Diagnosis.—Shell moderate to large in size. Spire concave to flat, or very low. Protoconch globular, with blunt nucleus. Above the shoulder, whorls weakly concave, smooth or with fine spiral striae; sutures impressed. Below shoulder, body whorl smooth, basally with spiral lines, and wide impressed anal depression, siphonal fasciole present. Aperture wider below. Anteriorly weakly notched. Outer lip prosocyrt.

Remarks.—Wenz (1943) gives the range of *Lithoconus* questionably from the Cretaceous (Senonian), to Recent.

Conus (Lithoconus) nocens, new species
Plate 19, figures 9–10

Description.—Shell small, protoconch of two and one-half smooth whorls. Spire whorls with five or six spiral lines. Below the carina early whorls ornamented with weak oblique nodules, later ones smooth. Body whorl a straight cone, smooth, base with strong punctate, crowded spiral lines. Columella terminated with a strong, very oblique fold, siphonal fasciole weak.

Remarks.—Four characters in combination serve to distinguish this species from *Conus (Lithoconus) sauridens* Conrad, 1833b, the common cone from the Cook Mountain Formation: the flat sides, the sharp unridged carina, the coarse, strong, spiral basal lines, and the lack of strong growth lines on the ramp. The growth lines on Cook Mountain specimens generate a characteristic reticulated pattern on the ramp where they cross the spiral lines. As Palmer (1937, p. 461) has already noted, the height and shape of the spire in this species is so variable as to preclude use of that feature in a definite determination. I have a large collection of cones from the Weches Formation where the common species is also referred to *C. (L.) nocens.* These specimens show a slightly rounded carina, giving the whorl profile a weakly sinuous profile but still far closer to the type than is *C. (L.) sauridens.* The largest Weches specimens of *C. (L.) nocens* tend to have obsolescent basal spiral lines on the abapertural side but keep them adaperturally. Larger Cook Mountain specimens of *C. (L.) sauridens* develop a strong, swollen siphonal fasciole, whereas *C. (L.) nocens* does not. The systematics of the Middle Claibornian cones is badly in need of revision; at least another three well characterized species can be recognised aside from *C. (L.) sauridens.*

Etymology.—The specific name is a play on the type locality, "Devil's Eye".

Type information.—Holotype: UT-TMM 84822; paratype: UT-TMM 84823. Type locality: locality 11. Holotype length, 20.0 mm.

Material examined.—Two Reklaw specimens, 25 Weches specimens, 100+ Cook Mountain specimens.

Family **TURRIDAE** H. and A. Adams, 1858, p. 614[15]

Subfamily **TURRICULINAE** Powell, 1942, p. 29

Genus **TURRICULA** Schumacher, 1817, p. 217

Type species.—Turricula flammea Schumacher, 1817, by monotypy. Recent from the Indo-Pacific.

[15] Swainson (1840) has been credited with the definition of the name Turridae although he uses the name Pleurotomidae. H. and A. Adams (1858) use Turrinae in the first page of the index of volume 1 to refer to Turritidae and Turritinae on p. 87. On p. 246, they note a new suborder established by Dr. Gray on the basis of anatomical characters; in volume 2, p. 614, the names Turridae and Turrinae are formally established.

Diagnosis.—Shell fusiform, usually shouldered, carinate, with a long, straight or slightly bent, narrow canal. Sculpture varying from smooth to strong spirals, often nodular where crossed by growth lines. Protoconch of two to two and one-half smooth whorls. Anal sinus on the shoulder slope, moderately deep, wide and U-shaped; outer lip thin.

Remarks.—Powell (1966) has *Turricula* ranging from the Eocene to Recent. *Turricula* s.l. appears to occur in the Upper Cretaceous of the Gulf Coast.

Turricula sp.
Plate 19, figures 13–14

Description.—Shell small, moderately inflated. Whorls with subsutural collar, concave ramp, jutting carina and constricted below; body whorl broadly rounded. Ornament of numerous spiral lines; with weak folds below the carina on early whorls; elongated riblets on the subsutural collar generated by the growth lines, stronger on later whorls. Columella straight and smooth.

Remarks.—The one specimen found of this genus is missing the protoconch, and part of the outer lip and canal. Palmer and Brann (1966) list five species of *Turricula* from the Paleocene and Eocene of the Gulf Coastal Plain; none of these shows much similarity to the present species. This species is remarkably similar to *Turricula planetica* (Edwards, 1856), from the Eocene Bracklesham and Barton beds of southern England, and can be distinguished from that species by the lower position of the carina, the more prominently defined collar, and the noded character of the whorls below the carina on the early whorls.

Material examined.—One specimen, 22 mm length. Location 20, unit F. Figured specimen: PRI 30560.

Genus **SURCULOMA** Casey, 1904, p. 153

Type species.—Pleurotoma tabulata Conrad, 1833b, by original designation. Middle Eocene, Gosport Sand Formation of Alabama.

Original diagnosis.—". . . the small paucispiral embryo is very nearly the same in general form [to *Amblyacrum,* Cossmann, 1889] . . . In *Surculoma* the beak is rather slender and somewhat abruptly formed below the convexity of the body whorl, the ribs large and few in number, the spire whorls always more or less angulate in profile at the periphery and the sculpture invariably consists of minute and very close-set spiral lines." (Casey, 1904, p. 153)

Subgenus **VOLUTAPEX**, new subgenus

Type species.—Surculoma calantica Harris, 1937, herein.

Diagnosis.—Shells like *Surculoma* but with a bluntly mammilate nucleus, spiral striation most obvious anteriorly. Ribbing typically having a vertically pinched appearance, thus producing whorls or a more or less carinated aspect. (after Harris, 1937, p. 55)

Remarks.—Harris (1937, p. 55) proposed *Volutapex* as a section of *Surculoma*; the latter taxon defined as a subgenus of *Turricula,* and thus *Volutapex* had then no formal taxonomic status. Palmer and Brann (1966) use *Volutapex* as a subgenus and list eight species under that taxon, but do not give a diagnosis or figure of the type species so the taxonomic status remained unchanged. Powell (1966) briefly discusses *Volutapex* but does not believe it deserves more than sectional significance. In my experience, the Claibornian species assigned to *Volutapex* form a natural group and should be given more than sectional status. Harris, 1937, notes *Surculoma calantica* Harris, 1937, may be regarded as typical and includes four other species in the section; the Reklaw species described in the next section fits readily in Harris's group. The group appears restricted to the Eocene of the Gulf Coast.

Surculoma (Volutapex) imbricata, new species
Plate 20, figure 14

Description.—Shell medium sized, elongate fusiform. Whorls ten, protoconch obtuse, blunt and mammillate, of one smooth volution; the remaining whorls strongly carinate and possessing a sharp keel. Shoulder concave with indications of a faint subsutural collar, profile convex below the keel, six to eight longitudinal folds per whorl, strong below and fading out below the collar. Surface ornamented with numerous close-set, sharp, collabral striae and irregular, spiral lines, both obsolescent on the shoulder; below the keel a few stronger spirals. Where the spiral lines cross the longitudinal ones a minute muricate ornament is developed that is stronger on the shoulder. Base of the body whorl with stronger spiral lines which alternate in size on the beak. Aperture ovate, outer lip sharp, incurved and smooth within. Columella long and slightly twisted, siphonal fasciole variable in strength. Umbilical depression usually present.

Remarks.—The strength of the siphonal fasciole is quite variable; thin-shelled specimens have a very weak fasciole and almost no umbilical depression, thicker specimens have a prominent, strongly twisted fasciole, and a larger depression; in one case the umbilical depression is developed into a small false umbilicus. A close representative is *Surculoma penrosei* (Harris, 1937). The Reklaw specimens have a more prominently imbricated ornament, much more angular whorls, a concave shoulder and are generally shorter.

Etymology.—The specific name *imbricata* notes the imbricate character of the whorls.

Type information.—Holotype: PRI 30460; paratypes: PRI 30461–30463. Type locality: locality 20.

Material examined.—140 + specimens, the largest: 28.0 mm length, 10.3 mm width.

Genus **LYROSURCULA** Casey, 1904, p. 156

Type species.—Lyrosurcula elegans Casey, 1904, by subsequent designation (Powell, 1942, p. 16). Claibornian Eocene of the United States.

Diagnosis.—Shell with multispiral conical protoconch, initially smooth then with widely spaced arcuate riblets. Teleoconch whorls with large fasciolar surface, spirally lirate throughout, with axial ornament of angular, large, barely inflated costae separated by regular depressions that are strong below the fasciolar surface, and weak or obsolete above. Aperture and canal long, columella straight and smooth.

Remarks.—The teleoconch sculpture is very distinctive but usually poorly described. A common character of shells is a regular arrangement of nodes, or spines, superimposed on a regularly conical spire; the genus *Lyrosurcula* has an unusual arrangement where regularly arranged, radially depressed areas, or dimples, are seen instead of nodes or spines. The genus is known only from the Eocene of the Gulf Coast.

Lyrosurcula cf. **vaughani** (Harris, 1895a)
Plate 20, figures 16–17

Pleurotoma vaughani Harris, 1895a, p. 57, pl. 4, fig. 8.
Lyrosurcula vaughani (Harris). Casey, 1904, p. 157; Harris, 1937, p. 82, pl. 13, fig. 38; fig. 39; Brann and Kent, 1960, p. 516; Palmer and Brann, 1966, p. 746.

Remarks.—Two juveniles are assigned to this species. *L. vaughani* ranges from the Weches Formation to the Upper Cook Mountain Formation. The only differences observed are the more pointed protoconch and generally sharper spiral ornamentation of the Reklaw specimens. More material will have to be discovered before it can be determined whether these differences are significant or not.

Type information.—Holotype: TBEG 35616, from the Weches Formation. Type locality: banks of Colorado River at Smithville, Bastrop County, Texas. Figured Reklaw specimen: PRI 33130.

Genus **PYRAMIMITRA** Conrad, 1865a, p. 28

Type species.—Mitra terebraeformis Conrad, 1848, by monotypy. Gosport Sand Formation of Alabama.

Diagnosis.—Shell small, slender. Protoconch multispiral, initially smooth, later longitudinally costate, nucleus small. Whorls feebly convex, with impressed suture and longitudinal ribs and spiral lines. Body whorl one-third to one-half the total height, convex and with short neck. Aperture small, canal short and bent. Columella short, straight, with one to two folds.

Remarks.—The genus is known from the Eocene and Oligocene of North America and Europe.

Subgenus **PETRAFIXIA** Cossmann, 1901b, p. 127

Type species.—Fusus koeneni Cossmann and Lambert, 1884, by monotypy. Estampes Oligocene of France.

Diagnosis.—Shell very small. Body whorl about one-half of the total height. Outer lip thin, smooth inside. Columella with one fold at the beginning of the canal.

Remarks.—To date *Petrafixia* is known only from the Oligocene of Europe

Pyramimitra (Petrafixia) eocenica, new species
Plate 20, figures 8–9

Description.—Shell very small, slender. Whorls six and one-half to seven; protoconch of three and one-half whorls, the first two and one-half smooth, rounded and with a subsutural line, the last with well developed longitudinal riblets. Adult whorls smooth and polished, sculptured with six longitudinal ribs per whorl and three spiral lines of about equal strength, one below the suture and two in the mid-section of the whorl, the ribs more prominent where they cross the ribs. Some specimens have a fine, intermediate spiral stria below the subsutural line. Occasionally a fourth rib is uncovered by the succeeding whorl. Suture moderately impressed, becoming strongly so by the final whorl; growth lines widely arcuate with the base of the sinus on the second line. Body whorl with seven or eight spiral lines and six or seven more on the base. Aperture elliptical, outer lip thin, smooth within; columella very short and straight, sharply terminated on the left and bounded below by a very weak fold. Canal short, twisted and bent to the left.

Remarks.—This species is easily distinguished from its closest relative *Pyramimitra terebraeformis* (Conrad, 1848), by the differing spiral sculpture and the lack of two columellar plications. Conrad (1848), originally places *P. terebraeformis* under *Mitra,* due no doubt to its mitrid proportions and strong columellar folds; in 1865 he creates the monotypic genus *Pyramimitra* for it. In 1901b Cossmann creates the family Pyramimitridae to include *Pyramimitra* s.s. and one subgenus *Petrafixia.* Excepting Wenz (1943), who places it in the Buccinidae; other authors, viz. Palmer (1937), Harris and Palmer (1946), Palmer and Brann (1966), and Dockery (1977), follow Cossmann in his placement. Cossmann (1901b, p. 125) gives a synopsis of what he regarded as the evolution of *Pyramimitra* in which *Petrafixia* is the evolutionary descendant of

Pyramimitra s.s. in a line which terminated in *Pisanella* Koenen, 1865. It appears more probable that *Petrafixia* is the ancestor and the Oligocene species *P. (P.) koeneni* in France is a separate offshoot. I have collected specimens of a *Pyramimitra* from the Weches Formation at Burleson Bluff, on the Brazos River, which are intermediate in character between *P. (P.) eocenica* and *P. terebraeformis,* which make the proposed development more plausible. The Reklaw species has an anal notch on the upper part of the whorl, which suggests that the genus belongs in the Turridae rather than the Buccinidae. It might be argued that the notch is of a similar character to that seen in *Surculites* Conrad, 1865d, a genus which Wrigley (1939) removed from the Turridae and placed in the neighborhood of the Fusinidae and Buccinidae. Wrigley's argument centered on the fact that the so-called notch on *Surculites* is dependent on the size of the carina, essentially straight on the early whorls, and increasingly sinuous on later ones. This is not the case in *P. (P.) eocenica* and to a lesser extent in the undescribed Weches species; in these species an anal notch is observed immediately after the protoconch. The protoconch too, is more typical of some Turridae, with the early, smooth whorls and the later, ribbed ones, rather than of a Buccinid family member. Several genera such as *Microsurcula* Casey, 1904 and *Lyrosurcula* Casey, 1904, have a very similar protoconch, and in the case of *Microsurcula* a similar apical sculpture too. Harris (1937) places *Microsurcula* as a subgenus of *Raphitoma* Bellardi, 1847, but following Powell (1966), it probably deserves full generic rank in the Turriculinae. In conclusion, the U-shaped sinus on the shoulder slope, type of protoconch and general similarity of the spire to *Microsurcula,* justify the transference of *Pyramimitra* to the Turriculinae. Even though *P. terebraeformis* and the closely related *Pyramimitra quadralirata* Dockery, 1977, do not show a definite turrid notch, the close taxonomic relationship to *P. (P.) eocenica* and short time interval between the species also justifies their transference to the Turriculinae. Powell (1966, pl. 7) illustrates several genera showing similarities to *Pyramimitra,* of which *Turridrupa* Hedley, 1922 appears particularly close.

Etymology.—The name *eocenica* notes the first reported occurrence of *Petrafixia* in the Eocene.

Type information.—Holotype: PRI 30464; paratype: PRI 30465. Type locality: locality 20.

Material examined.—Five specimens, the largest (broken) 3.1 mm in length.

Genus **PLEUROFUSIA** de Gregorio, 1890, p. 34

Type species.—*Pleurotoma longirostropis* de Gregorio, 1890, by original designation. Middle Eocene, Gosport Sand Formation of Alabama.

Diagnosis.—Shell moderate to fairly large in size; protoconch paucispiral, smooth, last quarter turn with arcuate riblets; spire high; sculpture of coarse ribs overriden by strong spiral cords; sinus broad, shallow, with the apex closer to the periphery than the suture; anterior canal long and unnotched.

Remarks.—This genus is restricted to the Eocene and Oligocene of Europe, and North and South America.

Pleurofusia? **huppertzi** (Harris, 1895a)
Plate 20, figures 21–22

Pleurofusia huppertzi Harris, 1895a, p. 58, pl. 4, fig. 9.
Turricula (Pleurofusia?) huppertzi (Harris). Harris, 1937, p. 52, pl. 10, fig. 9.
Pleurofusia? huppertzi (Harris). Palmer and Brann, 1966, p. 829; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 24.

Original description.—"Size and general form as indicated in the figure; whorls 11, one and two smooth, three to ten somewhat inflated submedially, longitudinally costae obtuse, most prominent submedially, almost vanishing on the subsutural portions of the whorls, becoming short and nodular on the upper whorls, prominently spirally striate, the striae often irregular and waving on the medial portions of the whorls; body whorl costate and spirally striate, striae becoming of alternate strength on the beak." (Harris, 1895a, p. 58)

Remarks.—The Reklaw specimens are more elongate and the nodular costation is less prominent on the later whorls than in *P. huppertzi* s.s., otherwise the specimens are very similar. The protoconch however, is not typical of *Pleurofusia,* in which it is described as blunt, paucispiral and smooth except for a few axial riblets on the last one-quarter turn. The present specimens have a conical protoconch of four turns, the nucleus minute and blunt, the first three smooth and rounded-carinate below the middle, and the last turn with axial riblets and a subsutural line that slowly increases in strength. The Reklaw species of *P. huppertzi* could be the immediate ancestor of *Pleurofusia claibarena* Harris, 1937 from the Gosport Sand Formation of Alabama; this latter species has a similar profile and the same number of nodulations per whorl. One specimen with a worn apex has much more subdued ornamentation, particularly so on the shoulder slope and is very much closer to the type; no intermediate forms have been discovered yet. The species ranges from the Reklaw to the Weches Formation, Middle Eocene of Texas.

Type information.—Holotype: TBEG 35618. Type locality: locality 8. Figured Reklaw specimen: PRI 30505.

Material examined.—350+ specimens, the largest (incomplete): 38 mm length, 9.9 mm width.

Genus **LEPTOSURCULA** Casey, 1904, p. 57

Type species.—Pleurotoma beadata Harris, 1895a, by monotypy. Middle Eocene, Weches Formation of Texas.

Original description.—"In this genus the form is very slender, fusiform, the canal very long, the aperture and canal together being about half as long as the entire shell. The embryo is relatively very large, higher than wide, conical and composed of five or six polished whorls, the lower whorls gradually acquiring close-set longitudinal riblets, and then equally gradually the spiral lyrae. The type is the very isolated *P. beadata* Harris, of the Texas Eocene, a slender and much elongated species, with a long slender and tapering beak. The series of small rounded close-set nodules forming the subsutural collar, are completely independent of the relatively large and oblique costae, which are less than half as numerous. the strong even lyrae are a particular feature." (Casey, 1904, p. 57)

Remarks.—To date this genus is only known from the type. It ranges from the Weches Formation to the Cook Mountain Formation of Texas.

Leptosurcula carinata, new species
Plate 20, figure 23

Description.—Shell small, protoconch of about four smooth, submedially carinated whorls, axially ribbed and spirally striate. Adult whorls medially carinated, with a duplex, beaded, raised subsutural line, and a concave shoulder with fine spiral lines and costate below, the costae overriden by coarser lines. Retral sinus an asymmetrical U with the apex closer to the periphery than the carina. Body whorl less costate than the preceding and ornamented with regular spiral lines which decrease slowly in strength towards the base. Canal long and strongly twisted.

Remarks.—One broken specimen was obtained, split longitudinally but showing sufficient characters for description. This is only the second species to be assigned to *Leptosurcula.* The broad U-shaped sinus occupying most of the shoulder slope indicates that the ancestor of the genus is perhaps to be found within the Turriculinae, perhaps near *Turricula* Schumacher, 1817. Harris (1937) placed the genus in the family Raphitomidae, subfamily Clavinae, so the discovery of this new species supports Powell's placement of *Leptosurcula* in the Turriculinae. The carinate whorls, weak shoulder ornamentation and smaller and more conical protoconch will distinguish the Reklaw species from the type, *L. beadata.*

Etymology.—Noting the prominently carinated whorls which differ from the type.

Type information.—Holotype: PRI 30466. Type locality: locality 4.

Material examined.—One specimen, 6.7 mm length.

Genus **EOSURCULA** Casey, 1904, p. 145

Type species.—Pleurotoma moorei Gabb, 1860, by subsequent designation (Vokes, 1939, p. 118). Middle Eocene, Weches and Cook Mountain formations of Texas.

Original diagnosis.—"The embryo in *Eosurcula* is much narrower than in *Protosurcula,* strongly elevated and smooth throughout, the subsutural collar smaller and less developed, the fasciolar surface thence obliquely ascending but straight in profile or nearly so to the obtusely angulate periphery, on and below which the spirals become coarser. The aperture and canal nearly as in *Protosurcula.* . . ." (Casey, 1904, p. 145)

Remarks.—The genus is known from the Gulf Coast Eocene and doubtfully also the California Eocene.

Eosurcula moorei reklawensis, new subspecies
Plate 20, figures 18–20

Description.—Shell large, elongate, fusiform in shape. Whorls nine to ten, protoconch high, of three and one-half smooth whorls, apex flattened and the nucleus minute. Adult whorls carinate, with numerous spiral lines, stronger on the subsutural collar and carina, weaker on the concave shoulder, alternating in size below the carina and on the body whorl. Excepting the shoulder area, the spiral lines are crossed by numerous close-set longitudinal lines. Small beads occur at the intersections of the spiral and longitudinal lines. Length of aperture and canal together half the length of the shell.

Remarks.—This subspecies is the most elongate of all the *E. moorei* group and is further distinguished by the absence of apical tubercles and the presence of beaded surface ornamentation.

Etymology.—The specific name notes the Reklaw Formation where the species is found.

Type information.—Holotype: PRI 30470; paratypes: PRI 30471, 30472. Type locality: locality 20.

Material examined.—150 + specimens, the largest complete: 19 mm length, 5 mm width. Broken specimens indicate an original size to 40 mm length.

Genus **TROPISURCULA** Casey, 1904, p. 153

Type species.—Pleurotoma (Drillia) caseyi (Aldrich, 1903b), by subsequent designation (Harris, 1937, p. 57). Red Bluff Oligocene of Mississippi.

Original diagnosis.—"The shell in this genus is

small in size, of slender form, with moderately elongate and slender beak and narrow, closely-coiled, multispiral embryo, which is higher than wide, and perfectly smooth and polished throughout. The ribs are about equal in number to those of *Pleurofusia* but culminate in transverse prominences at the summit of an angulate median periphery, and sometimes become gradually feebler on the larger whorls. The spiral lines are subequal amongst themselves, relatively rather coarse but low, and very close-set throughout." (Casey, 1904, p. 153)

Remarks.—The genus is often confused with *Surculoma* Casey, 1904, and indeed the adult sculpture of many of the Tertiary Gulf coast species is remarkably similar. The blunt, mammilate apex and paucispiral protoconch of *Surculoma* (most species now separated out under *Volutapex* (Harris), can distinguish species of that genus from *Tropisurcula*. The genus is known from the Eocene of the northern hemisphere.

Subgenus **TROPISURCULA** s.s.

Tropisurcula (Tropisurcula) milamensis, new species
Plate 21, figures 1–2

Description.—Shell small, fusiform, with short beak. Whorls 10 to 11, protoconch bluntly conical, of three to three and one-quarter smooth, polished whorls. Adult whorls with five or six oblique, nodose ribs, obsolete below the collar. Subsutural collar large, rounded, and wavy due to the prominent development of the ribs on the previous whorls. Surface with spiral lines, one medial line causing the whorls to be acutely carinated, another weaker one above the carination and a third above the lower suture. Fasciolar surface with fine striae. On later whorls, intermediate lines develop, becoming subequal in size particularly so below the carina. Body whorl with ribs absent at the initiation of the beak where the lines are stronger again. Sinus a broad open V, occupying the entire fasciolar surface. Aperture long, rounded, trapezoidal, outer lip thin and lirate within. Columella smooth, oblique and reflected. Aperture and canal two-fifths the length of the shell.

Remarks.—This species is closest to *Tropisurcula planus* n. sp. but has a shorter aperture and canal, and coarser ornamentation. The closest described species is *Tropisurcula caseyi* (Aldrich, 1903b) from the Red Bluff Oligocene of Mississippi. The Reklaw specimens are more elongate, have finer lines on the shoulder and coarser ones below, no well-defined keel, and stronger, more widely-spaced costae.

Etymology.—The specific name refers to the first discovery in Milam County, Texas.

Type information.—Holotype: PRI 30478; paratypes: PRI 30479–30482. Type locality: locality 20.

Material examined.—400+ specimens, the largest 10.0 mm length, 3.0 mm width.

Subgenus **EODRILLIA** Casey, 1904, p. 159

Type species.—*Pleurotoma depygis* Conrad, 1833b, by subsequent designation (Cossmann, 1906, p. 223). Eocene, Gosport Sand Formation of Alabama.

Diagnosis.—Shell smooth or finely spirally striate; protoconch conical, smooth, of three to three and one-half whorls; ribs well developed and not crossing the fasciolar surface; sinus broadly U-shaped, the center near the middle of the fasciolar surface; subsutural collar prominent; aperture short, canal very short.

Remarks.—Powell (1966, p. 45) places *Eodrillia* in synonymy of *Eopleurotoma* Cossmann, 1899, but the multispiral protoconch, strong subsutural collar and prominent rounded nodules separate that taxon well. Palmer and Brann (1966, p. 645) consider Cossmann's selection of *Pleurotoma depygis* as the type unfortunate, as a unique specimen of *P. depygis* still needs to be selected from the type lot of about 20 specimens. Harris (1937, p. 37), believed both the types of *P. depygis* and *Pleurotoma nuperus* Conrad, 1833b were contained in that type lot, which he noted represents the larger part of the Conrad *Eopleurotoma* collection. It appears that *P. depygis* as figured in Harris (1937, pl. 6, figs. 18–19, pl. 7, figs. 1–2) does represent a *Eopleurotoma* species with its long narrow flexuous ribs, and the apex of the V-shaped anal sinus just above the peripheral nodules. The problem is that Casey (1904, pp. 159–160) included *P. depygis*, which he synonymized with *Drillia laevis* Conrad, 1865a. This latter species is a *nomen nudum* as it only appears in Casey's list of species; other typical species mentioned by Casey include *Pleurotoma texana* Conrad, 1865a, and *Pleurotoma lonsdali* I. Lea, 1833, both now included in *Eodrillia* by Palmer and Brann (1966). The remainder of Casey's species are turrids figured by de Gregorio and since lost, although from the figures they also appear to be in *Eodrillia*. Moore (1962, p. 68) reported the type of *D. laevis* missing. Amongst Katherine Palmer's personal papers, however, is a photograph of *D. laevis* with the word "type" written on it; this photograph shows a specimen which appears to be identical to *P. lonsdali*. (These papers are now in the archives of The Paleontological Research Institution, Ithaca, NY.) It seems fairly clear that Conrad himself regarded *P. depygis* as a drillid as he includes *P. lonsdali* in synonymy. The best conclusion is that *P. depygis* is an *Eodrillia* as listed by Palmer and Brann (1966, p. 645), but that the figures and specimens shown by Harris are not Conrad's *P. depygis*. Genus

Eodrillia seems hardly deserving of full generic rank, as the same type of protoconch, nodular ribs and anal sinus are also seen in *Tropisurcula*. If forms like *Eodrillia texanopsis* (Harris, 1895a), with the long beak and canal, are also accepted as belonging to this taxon then the break between them and smoother forms of *Tropisurcula planus* is negligible indeed.

Tropisurcula (Eodrillia) planus, new species
Plate 21, figures 3–4

Description.—Shell small, fusiform with conical spire. Whorls nine and one-half; protoconch bluntly conical, of three and one-half to four smooth whorls. Adult whorls with six or seven rounded, oblique, nodose ribs, obsolete on the concave fasciolar surface. Suture wavy due to the prominent development of the ribs on the shoulder; subsutural collar thickened, sometimes duplex. Surface with numerous revolving lines, finer and more closely set on the fasciolar surface, larger and more widely spaced below. A feeble carina is formed with the first of the larger spiral lines positioned just above the whorls' maximum diameter. On the body whorl the most prominent line ends at the initiation of the canal, the other lines being more closely set towards the anterior end. Sinus broadly V-shaped, occupying most of the shoulder area. Aperture elongate-oval, outer lip thin and smooth within. Columella smooth and bent to the left. Aperture and canal together make up half the length of the shell.

Remarks.—This species is close to *Tropisurcula (Eodrillia) texanopsis* (Harris, 1895a), but may be distinguished by the shorter apex, the lack of polished whorls, the slight medial carination and multispiral, blunt protoconch. *T. (E.) planus* can be separated from other *Tropisurcula* species by its more elongate form, almost obsolete carination, and generally more subdued ornamentation.

Etymology.—The specific name *planus* (Latin, flat), refers to the smooth, flat shoulder.

Type information.—Holotype: PRI 30473; paratypes: PRI 30474–30477. Type locality: locality 20.

Material examined.—350+ species, the largest 15.0 mm length, 5.0 mm width.

Tropisurcula (Eodrillia) grandis, new species
Plate 21, figures 5–6

Description.—Shell broadly fusiform. Whorls nine and one-half; protoconch conical of three and one-half to four smooth whorls. Whorls with seven or eight prominent, rounded, nodular costae; a concave subsutural collar made wavy due to the costae on the previous whorl, and fine spiral lines almost obsolete on the collar. The lines are a little stronger and more widely spaced on the lower half of the whorls, strong on the beak. Anal sinus a broad V with the rounded apex in the center of the fasciolar slope. Aperture elongate, columella long, smooth, bent weakly to the left.

Remarks.—This Reklaw species resembles *Tropisurcula (Eodrillia) planus* n.sp. more closely than any other, and is distinguished from that species by its larger spiral angle, greater size and the strongly wavy subsutural collar formed by the strong costae. *T. (E.) grandis* lacks the short aperture and beak, and strong polish of *Tropisurcula (Eodrillia) texana* (Conrad, 1865a) from the Cook Mountain Formation, and the other previously described *Eodrillia* species. Several specimens do show a slight polish on the whorls.

Etymology.—Referring to the relatively large size of this species.

Type information.—Holotype: PRI 30478; paratype: PRI 30553. Type locality: locality 4.

Material examined.—Nine specimens, the largest: 16.9 mm long, 3.8 mm greatest diameter.

Genus **PROTOSURCULA** Casey, 1904, p. 144

Type species.—Surcula gabbi Conrad, 1865a, by original designation. Middle Eocene of Texas.

Original diagnosis.—"In this genus and *Eosurcula* there is no trace of ribbing, and the moderately large species comprising them may be considered allied more closely to the Cochlespira group than any other; the embryo in both is conical or conoidal and multispiral, and, in *Protosurcula* this is generally very large and with conspicuous longitudinal riblets on the lower whorls. The collar below the suture is cariniform and the long fasciolar surface between it and the obtuse periphery is broadly concave and with fine spiral lines; below the periphery the spiral lyrae are rather coarse. The columella is straight and generally simple, though sometimes having strong plicae above the middle. The spire tapers evenly to the apex and the beak is slender and frequently very long, the aperture and the long canal combined being much larger than the remainder of the shell in *gabbi* which is assumed to be the type." (Casey, 1904, p. 144)

Remarks.—Protosurcula to date is known from the Claiborne of the Gulf Coast and Northern Mexico.

Protosurcula? **aurora**, new species
Plate 21, figures 7–8

Description.—Shell large, fusiform. Whorls 12; protoconch bluntly conical, of four and three-quarters to five whorls, nucleus inflated and partially immersed, first one-half whorl deviated, the first three and one-half whorls smooth, shining and carinated below the middle, the succeeding whorls slowly developing widely spaced arcuate riblets and numerous spiral lines. The spiral lines continue and become part of the

adult ornamentation whereas the riblets abruptly cease above the medial carination, the lower part continuing as a slowly vanishing crenulated keel. Adult whorls with a rounded carina that migrates from a submedial to a medial position and a collar that becomes progressively more crenulate. Surface covered with numerous spiral lines, larger on the collar and on the central carination. Body whorl coarsely spirally striate and with finer intermediate lines. Aperture ovate, columella long and straight.

Remarks.—This species is obviously directly in the phylogenetic line of *Protosurcula tenuirostris* Casey, 1904 from the Weches Formation, and *Protosurcula gabbi* (Conrad, 1865a) from the Cook Mountain and Laredo formations. The adult shell profile has stayed fairly constant throughout the development of the genus whereas the protoconch has changed radically. In *P.? aurora* the anterior part of the protoconch resembles the later adult sculpture and no demarcation is discernible. The Weches species *P. tenuirostris* is higher and lacks the spiral striation of the Reklaw species. Well-preserved specimens of *P. gabbi* sometimes show a multispiral highly conical protoconch topped by three to four whorls forming a minute vertical pillar. Specimens labelled "*P. gabbi*" from St. Maurice, Louisiana and from the Lewis House, 5.3 km east of Alto, Cherokee County, Texas, all in the Academy of Natural Sciences, Philadelphia, show some of the ribbing continuing on to the later whorls and having a more crenulated collar; these specimens appear to be in an intermediate stage of development between *P.? aurora* and *P. gabbi.*

Etymology.—The specific name *aurora* (Latin, dawn), notes the first known occurrence of the *Protosurcula* stock.

Type information.—Holotype: PRI 30483; paratypes: PRI 30484–30487. Type locality: locality 20.

Material examined.—200+ specimens, the largest complete one: 34 mm length, 9.5 mm width. One broken specimen measures 13.5 mm width.

Subfamily **TURRINAE** Swainson, 1840, p. 154[16]

Genus **CORONIA** de Gregorio, 1890, p. 23

Type species.—*Pleurotoma acutirostra* (Conrad, 1834) (= *Pleurotoma childreni* I. Lea, 1833), by subsequent designation (Palmer and Brann, 1966, p. 607). Eocene, Gosport Sand Formation of Alabama.

Original diagnosis.—"Testa turriculata; anfractibus angularis, carina granulosa vel crenulata, ornatis, saepe etiam aliis duabis costis spiralibus, cariniformibus, laeigatis (ex quibus antica inter carinam et suturam anticam, postica inter carinam et suturam posticam sita est) praeditis; rima potius profunda, angulosa vel subangulosa in carina vel in ejus proximitata incisa." (de Gregorio, 1890, p. 23)

Translation.—Shell turriculate, whorls angular, spiral sculpture strongest near the carina; carina crenulate or nodular, often defined with a duplex crenulated spiral line; sinus broad and not too deep, situated on the carina; sutures deeply impressed.

Remarks.—The genus is known from the Eocene of the Gulf Coast.

Coronia taylori, new species
Plate 19, figures 17–19

Description.—Shell small, whorls 10 to 11, protoconch high, of three and one-half to three and three-quarters whorls, the first one and one-half smooth, the remainder with fine riblets that are initially arcuate and becoming progressively more acute and finally protractive. Nucleus minute and partially immersed. Spire whorls submedially carinated, defined by an elevated band of regular squarish nodules. Suture deeply impressed, margined below with a strong cord; below that a concavity that initially contains one spiral line, with increasing age to up to nine or 10. Below the concavity is a keel, below that two strong lines, the lower one margining the suture. Body whorl with strong subequal spiral lines that decrease in size below the middle. Aperture elongate-oval, with a gutter and long, straight canal bent slightly to the left.

Remarks.—This appears to be the ancestor of *Coronia genitiva* Casey, 1904 from the Weches and Cook Mountain formations in Texas, to which it bears a close resemblance. The specimens can be separated into two groups on the type of protoconch, which in one group is slightly higher and has more widely spaced riblets than the other. The difference however, is not considered significant enough even for subspecific rank and may indicate sexual dimorphism in the species. A few specimens show the peripheral keel tending towards a duplex character, as in *Coronia childreni* (I. Lea, 1833). The *Coronia* group, comprising *C. childreni, Coronia margaritosa* (Casey, 1904) and *C. genitiva,* seems over-differentiated, the primary feature of all being the strong keel, which has one strong line above it and two below. The Reklaw species can be separated from the above-mentioned group of three by the combination of the nodules on the spire which occur conspicuously below the middle of the whorl, the stronger carina and spiral lines, and the smaller protoconch.

Etymology.—The specific name refers to Joe Taylor Creek where the species is abundant.

Type information.—Holotype: PRI 30561; paratypes: PRI 30562–30566. Type locality: locality 20.

[16] = Pleurotominae Swainson, cf. McLean, 1971.

Material examined.—250+ specimens, the largest 21 mm in length, 5.0 mm width.

Coronia cf. **margaritosa** (Casey, 1904)
Plate 20, figures 10–11

Gemmula margaritosa Casey, 1904, p. 135; Harris, 1937, p. 16, pl. 2, fig. 14, 15, 17, figs. 16, 8
?*Coronia margaritosa* (Casey). Gardner, 1945, p. 240, pl. 27, fig. 7
Coronia margaritosa (Casey). Dockery, 1980, p. 126, pl. 41, fig. 7

Original description.—"Whorls with two rather widely spaced separated carinae below the suture, embryo relatively small in size, somewhat higher than wide, with three smooth spiral whorls, gradually increasing as usual, and two whorls covered with coarse and rather widely spaced riblets; peripheral duplex carina not strongly elevated, the space between it and the lower and larger of the subsutural carinae about twice as wide as the peripheral band and having two spiral threads and sometimes three other smaller ones in addition; space below the periphery with several spiral carinules; shell rather large, the beak straight but somewhat feebly, obliquely swollen towards tip; length of the aperture and canal together nearly two-fifths the length of the shell. Length of a specimen having nine body whorls 27 mm; width 7.8 mm Lower Claiborne Eocene of Smithville, Texas " (Casey, 1904, p. 135)

Remarks.—Only one specimen was obtained of this species. It is most closely allied to *C. margaritosa* but also shows affinities with *Coronia genitiva* (Casey, 1904). Juvenile specimens of *C. margaritosa* from the type locality at Smithville are very similar, but with increasing age the duplex subsutural carina becomes larger than the crenulated medial carina, giving a wholly different aspect to the shell. This specimen is close to that figured by Harris (1937, pl. 2, no. 14), a species from the lower Claiborne of Hickory, Mississippi. The species is reported from the Weches, Cook Mountain and Laredo formations in Texas, Mississippi and Mexico.

Type information.—Holotype: USNM 494348. Type locality: Smithville, Bastrop County, Texas. Figured Reklaw specimen: PRI 33186, from locality 4.

Material examined.—One specimen, 9 mm in length.

Genus **HESPERITURRIS** Gardner, 1945, p. 237

Type species.—*Turris nodocarinatus* Gabb, 1860, by monotypy. Claibornian Eocene of Texas.

Original diagnosis.—"Shell rather small or of moderate dimensions, slender, multispiral, the body rather abruptly constricted into the short anterior canal. Protoconch of genotype of five to five and one-half whorls, the initial turn minute and largely immersed, the three to three and one-half succeeding whorls smooth, shining, broadly rounded, and increasing rather rapidly in diameter, the final whorl in whole or part axially costate, the costae feebly arcuate. Sculpture elaborate, entire conch spirally lirate; peripheral and sutural collar noded, the peripheral nodes protractive, commonly confined to the peripheral area and obsolete towards the aperture. Posterior fasciole moderately wide, depressed. Sinus broadly U-shaped, moderately deep, the axis running closer to the periphery than to the posterior suture." (Gardner, 1945, p. 237)

Remarks.—To date five species or subspecies of this Eocene genus have been recognized, two of them restricted so far to Mexico.

Hesperiturris nodocarinatus crassus,
new subspecies
Plate 20, figures 1–3

Description.—Shell narrow, fusiform; protoconch bluntly conical, of three and one-half to four whorls, initially smooth, the last one-half to three-quarters whorl with widely spaced arcuate riblets. Nucleus moderately swollen and partially immersed. Adult whorls carinate below the middle and with a moderately swollen subsutural collar. Surface ornamentation of about 20 small collabral folds, most prominent on the carina, slightly less so on the collar and obsolete below the carina. The entire surface covered with spiral lines which increase in strength as they approach the lower suture. Body whorl with strong spiral lines increasing in strength on the beak. Sinus moderately deep (similar to *H. nodocarinatus* s.s.). Columella slightly oblique, canal long and bent to the left.

Remarks.—The difficulty of placing members of the *H. nodocarinatus* stock was commented on by Harris (1937, p. 34) and the assignment of these specimens to a subspecies of that is made primarily to emphasize its relationship to *Hesperiturris nodocarinatus* (Gabb, 1860), even though it may deserve full specific rank. The same wide variation of characters seen in *H. nodocarinatus* s.s. is also observed in the Reklaw specimens. The whorl profile ranges from almost flat to strongly carinate and the strength of the longitudinal folds ranges from strong to almost obsolete, particularly on the later whorls. The characters that are relatively constant and that can be used to differentiate the subspecies are the smaller swollen protoconch, the stronger spiral lines and the longitudinal folds, which persist between the medial carina and the subsutural collar. *Hesperiturris nodocarinatus enstrictus* (Harris, 1895a) from the Weches Formation has characters intermediate between the Reklaw Formation and Cook Mountain Formation species. A probable ancestor is *Eopleurotoma cainei* (Harris, 1899) from the Sabinian

stage, this species has the ribs more constant in strength, more evenly rounded whorls and stronger spiral lines.

Etymology.—The subspecific name *crassus* (Latin, coarse), notes the rougher ornamentation of this species.

Type information.—Holotype: PRI 30449; paratypes: PRI 30450–30453. Type locality: locality 20.

Material examined.—400+ specimens, the largest 21.5 mm length, 7.0 mm width.

Hesperiturris? **monilis**, new species
Plate 20, figures 12–13

Description.—Shell solid, very small. Whorls eight. Protoconch conical of about four whorls, initially smooth, the last one to one and one-quarter whorls with fine riblets; nucleus swollen and partially immersed. Sculpture consists of a submedial row of axially elongated beads (16 to 18 on the body whorl), a crenulated subsutural beaded line with each bead corresponding to a submedial one, and one, rarely two, fine lines between the two rows of crenulation. A further smaller line borders the lower suture. Body whorl with four prominent lines beneath the strongly beaded spiral, occasional fine intermediate lines occur. Sinus a broad U, the center near the top of the submedial beads. Aperture elongate-oval with a prominent gutter; outer lip sharp, inside smooth, columella straight and smooth, callus deposit absent; canal twisted, moderate in size, bent and slightly emarginate, basally notched.

Remarks.—There seems to be nothing closely related to this species; superficially it might be taken to be a species of *Coronia.* The protoconch of *H.? monilis* with its widely spaced arcuate riblets and the broadly U-shaped sinus place it closer to *Hesperiturris* rather than *Coronia,* whose protoconch has numerous very fine riblets and a sinus which is a broad V with a rounded apex. The relationship of *H.? monilis* to *H. nodocarinatus* s.s. is also made clearer by an examination of *Hesperiturris nodocarinatus enstrictus* (Harris, 1895). This species from the Weches at Smithville has characters intermediate in development between *H.?monilis* and *H. carinatus* s.s. from the Cook Mountain Formation. Another more distantly related species, that has a similar development of axially elongated nodes, is *Hesperiturris amichel* Gardner, 1945, from the Laredo Formation of Mexico. There is no known descendant of *H.? monilis* in the later Claibornian, but the sculpture of *Coronia? nodulina bunkerensis* (Harris, 1937) suggests a relationship.

Etymology.—The name *monilis* (Latin, necklace), notes the similarity to a string of beads.

Type information.—Holotype: PRI 30454; paratypes: PRI 30455, 30456. Type locality: locality 4.

Material examined.—45 specimens, the largest 8.7 mm length.

Hesperiturris? **monilis levae**, new subspecies
Plate 20, figure 15

Description.—Shell solid, very small; whorls eight, spire strongly cyrtoconoid. Protoconch conical of about four whorls, initially smooth, the last one to one and one-quarter whorls with fine riblets; nucleus swollen and partially immersed. Sculpture consists of a submedial row of weakly arcuate beads (22–26 on the body whorl), a crenulated subsutural beaded line with each bead corresponding to a submedial one, and one, rarely two, fine lines between the two rows of crenulation. A further smaller line borders the lower suture. Body whorl with four lines beneath the beaded spiral, occasional fine intermediate lines occur. Sinus a broad U, the center near the top of the submedial beads. Aperture elongate-oval with a prominent gutter; outer lip sharp, inside smooth, columella straight and smooth, callus deposit absent; canal twisted, moderate in size, bent and slightly emarginate, basally strongly notched.

Remarks.—This species is distinguished from *monilis* s.s. by its highly cyrtoconoid spire, more subdued ornamentation and more prominent anterior notch.

Etymology.—The subspecific name *levae* (Latin, smooth) notes the smooth ornamentation.

Type information.—Holotype: PRI 30448. Type locality: locality 20.

Material examined.—Two specimens, the largest: 6.0 mm length, 2.2 mm width.

Subfamily **BORSONIINAE** Bellardi, 1875a, p. 20

Genus **BATHYTOMA** Harris and Burrows, 1891, p. 113

Type species.—Murex cataphractus Brocchi, 1814, by monotypy. Eocene and Oligocene of the Paris Basin, France.

Diagnosis.—Shell small, solid, biconical. Protoconch conical, of one and one-half to three and one-half whorls, the apex smooth and pointed; the last whorl with arcuate riblets. Adult sculpture of closely spaced, spiral cords overriden by axial growth lines causing the spirals to be beaded. Whorls usually with a beaded carina and concave shoulder. Outer lip thin-edged, sometimes lirate within; sinus a broad, open V with a narrow U at the apex which is on the peripheral carina. Columella usually with distinct, oblique, submedial fold, canal short and shallowly notched.

Remarks.—The genus is widely represented in the Eocene of the U.S., and it occurs today in deep water in the Caribbean. In Europe it persisted until the Pliocene. In India and the Far East it ranges from the Oligocene to Recent times. The Claibornian species re-

ferred to *Bathytoma* are very similar to *Glyptotoma* Casey, 1904; Harris (1937), regarded *Bathytoma* as a subgenus of the latter. *Glyptotoma* has a columella with a distinct ridge that splits into two or three strong folds, and also a strongly lirate outer lip.

Bathytoma cf. **nonplicata** Harris, 1937
Plate 20, figures 4–5

Bathytoma nonplicata Harris, 1937, p. 23, pl. 3, figs. 25, 25a; Brann and Kent, 1960, p. 118; Palmer and Brann, 1966, p. 525.

Original description.—"Form broad-turrited as figured; first embryonic whorl very minute, remaining three rapidly expanding and showing faint vertical ribbing below; subsutural band with pronounced beading, followed below by two to four crenulated spirals; peripheral duplex spiral pronounced, showing below one or two beaded spirals; body whorl anterior to the carination showing about fifteen beaded spirals, coarse at first but becoming finer and less beaded on the beak; lip within, with about eight rather fine but sharply defined spirals; columella entirely smooth." (Harris, 1937, p. 23)

Remarks.—The Reklaw species differs from *B. nonplicata* s.s. from the Cook Mountain Formation by the slightly weaker ornamentation, the gradual development of the ribbing on the protoconch, and a variable number of lirations within the outer lip; the number or lirations vary between zero and nine. The constant differences are considered great enough for separating the material. Gardner (1945, p. 248), regarded *Glyptotoma* as a subgenus of *Scobinella* Conrad, 1847, but the relationship seems closer to *Bathytoma,* as Powell (1966, p. 65) also noted. The relationship is also reinforced by observing that several of the Reklaw specimens show indications of three columellar folds under oblique lighting. The lack of lirations within the outer lip in the latter genus should not be used as a distinguishing character, as the discussion of Grant and Gale (1931, pp. 543–544) indicates.

Type information.—Holotype: PRI 2048a; paratype: PRI 2048b. Figured Reklaw specimen: PRI 30457, from locality 4.

Material examined.—40 Reklaw specimens, the largest: 8.5 mm length, 3.2 mm width.

Genus **DOMENGINELLA** Vokes, 1939, p. 121

Type species.—*Turris claytonensis* Gabb, 1864, p. 83, by original designation. Domengine Eocene, California.

Diagnosis.—Shell small, biconical, with moderately tall spire and gradually tapering body whorl ending in a short un-notched anterior canal. Adult sculpture with a prominent subsutural ridge, a concave shoulder with five beaded spirals and below that prominently beaded spiral cords. Outer lip lirate, columella smooth.

Remarks.—Vokes (1939) noted the great similarity of all features of this genus to *Scobinella* Conrad, 1847, except for the columella of *Domenginella,* which is smooth. Originally several species from the English Eocene were referred to this genus but modern authors have referred them elsewhere leaving *T. claytonensis* as the only species until now.

Domenginella ridgei, new species
Plate 20, figures 6–7

Description.—Shell moderate in size, solid, biconical. Whorls seven and three-quarters to eight, protoconch of four and one-half whorls, smooth and rounded except for the last whorl which is sculptured with widely spaced riblets. Adult sculpture of a smooth duplex subsutural collar, a concave sinus area with four spiral striae and obscurely crenate collabral growth threads. Below that, initially two and later three crenulated spirals, below that a narrowly excavated area. Body whorl and beak with up to 20 prominent beaded spirals, progressively weaker towards the base; interstitial weaker spirals sometimes present. Aperture quadrilateral, labrum with widely separated thin lirae, columella anteriorly marked by a low wide swelling, marking the beginning of a short canal. Two basal spirals continue into the aperture very indistinctly.

Remarks.—This is the first record of this West coast genus in the Gulf Coast Tertiary. A similar Gulf coast genus is *Moniliopsis* Conrad, 1865a, but that genus differs by the lack of plications on the labrum, a very narrow shoulder area, and lack of beaded ornamentation. The closest Claibornian species is the Reklaw clavid, *Bathytoma cf. nonplicata* n.sp.

Etymology.—Noting the occurrence in Ridge Creek.

Type information.—Holotype: PRI 30458; paratype: PRI 30459. Type locality: locality 4.

Material examined.—Three specimens, two juveniles and a large broken adult with only the last two whorls remaining.

Subfamily **CLAVINAE** Casey, 1904, p. 125

Genus **MICRODRILLIA** Casey, 1903, p. 276

Type species.—*Pleurotoma cossmanni* Meyer, 1887a, by subsequent designation (Cossmann, 1906, p. 223). Upper Eocene, Moodys Branch Formation of Mississippi.

Original diagnosis.—"They are all very small and characterized by a well-developed, multispiral, closely coiled embryo, having one to three of its basal whorls costulate, few body whorls which are wholly devoid of costae but spirally carinate, the rostral sinus relatively large, circularly rounded and close to the suture,

the aperture oblique, columellar callus, with or without plications, and the canal short or obsolete." (Casey, 1903, p. 276)

Remarks.—The Paleogene *Microdrillia* species are unnecessarily split; intergrades certainly exist between many of the Texas Claibornian Eocene populations when large samples are considered. To correctly determine the relationships a revision of all the Paleogene species should be conducted with sufficient samples of each. That is outside the range of this report. It is possible four species of *Microdrillia* exist in the Reklaw deposits; two are assigned with some confidence near existing taxa. Given the range of variation seen in these two, and knowing the variation in the Cook Mountain and Stone City species, it would be pointless to define the other two without more material. The genus is widely distributed from the Eocene to Recent.

Microdrillia rostratula Casey, 1903
Plate 21, figures 12–13

Microdrillia rostratula Casey, 1903, p. 277; Aldrich, 1921, p. 7; Palmer and Brann, 1966, p. 770, pl. 5, figs. 7, 8.

Original description.—"Base of shell distinctly rostrate; body whorls about four in number. Form stout, the spire whorls short, about three times as wide as long, with a sub-duplex subsutural collar and three other single carinae, the fasciolar surface with two fine revolving threads; beak short and broad; lines of growth strongly marked; embryo well developed as usual higher than wide, ovulate at tip, with three smooth and two costate whorls. length 5.7 mm, width 2.3 mm Lignitic Eocene. Wood's Bluff Horizon." (Casey, 1903, p. 277)

Remarks.—This Reklaw species is very similar to *M. rostratula* from the Sabinian Eocene. The two fine revolving threads on the fasciolar surface are a little lower, the intermediate, spiral lirae on the body whorl are weak to absent, and the protoconch riblets are finer than in the Wood's Bluff species, but the differences are not considered significant enough even for subspecific rank.

Type information.—Lectotype: USNM 481550. Type locality: Choctaw Corner, Clarke County, Alabama. Range: lower Eocene, Bashi Member (type), Sabine stage, Alabama; Reklaw Formation, Texas. Figured Reklaw specimen: PRI 30567, from locality 20.

Material examined.—48 specimens, the largest: 6.6 mm length, 2.7 mm width.

Microdrillia aff. **robustula** Casey, 1903
Plate 21, figures 14–15

Microdrillia robustula Casey, 1903, p. 277; Harris, 1937, p. 93, p. 14, figs. 38, 39, 48, 48a; Brann and Kent, 1960, p. 554, Palmer and Brann, 1966, p. 769. (Not p. 555, No. 2615c= *M. infans* (Meyer) ? var. Harris.)

Original description.—"Embryo as wide as high, obtusely oval at tip, with three smooth and two costulate whorls; subsequent whorls four in number, each with one subsutural and three other equal carinae; fasciolar surface without a revolving thread. Length 5.6 mm, width 2.25 mm. Lower Claiborne Eocene, St. Maurice La." (Casey, 1903, p. 277)

Remarks.—The Reklaw specimens can be separated into two groups, the first shorter with one and one-quarter to one and a half whorls of the final protoconch whorls ribbed, and the second group with a full two final protoconch whorls ribbed and quite elongate. Both groups have somewhat stronger spiral sculpture than *M. robustula* s.s. and have the lowest of the three lirae just above the lower suture. Several Reklaw specimens show one or more fasciolar threads, all other characters being similar. In my experience a large enough sample of any particular *Microdrillia* species always includes some specimens displaying this feature, so it is not considered to be of specific importance.

Type information.—Syntype: USNM 481559. Figured Reklaw specimen: PRI 33110, from locality 20.

Material examined.—14 specimens, the largest: 6.5 mm long.

Microdrillia sp.
Plate 21, figures 20–21

Remarks.—One of the remaining species, quite different from the two preceding described species, is figured here. Protoconch with three and one-half smooth whorls and one finely costulate one. Primary spire sculpture is dominated by two lines, a subsutural one and a slightly stronger submedial line. The form is rather similar to *Microdrillia harrisi* (Aldrich, 1895a) from the Cook Mountain Formation, but it lacks the columellar plaits and labial lirae.

Material examined.—Two specimens, from locality 4. Figured specimen: PRI 30568, 6.8 mm length.

Genus **SPIROTROPIS** Sars, 1878, p. 242

Type species.—*Pleurotoma? carinatum* Philippi, 1844a, by monotypy. Recent in Scandinavian seas.

Diagnosis.—Shell of moderate size, thin, fusiform, with strongly carinated whorls and a short, straight, un-notched anterior canal. Protoconch of about one and one-half to two smooth whorls ending in a sharp, medial carination. Adult sculpture initially with a few weak, peripheral nodes, then smooth and moderately to strongly carinate. Anal sinus U-shaped occupying most of the shoulder slope. Outer lip smooth within, thin and prominently swept forward. Columella nar-

row, smooth and bent, plicae absent, callus deposit thin.

Remarks.—According to Powell (1942), the distribution of this genus includes Scandinavia, the North Atlantic, Mediterranean and Canary Islands, mostly in deep water. The genus also occurs in the Miocene to Pleistocene in Europe and the Eocene of the West Coast of North America where it is represented by two species: *Spirotropis (Antiplanes) cf. bulimoides* (Dall, 1919) and *Spirotropis (Antiplanes) perversa fernandoensis* (English, 1914).

Spirotropis claibornica, new species
Plate 21, figures 16–17

Description.—Shell very small, whorls seven and one-half. Protoconch of one smooth, inflated whorl followed by one-quarter whorl that is sharply medially carinated; nucleus inflated and flattened. Adult whorls with a rounded carina, initially in the medial position and becoming increasingly higher on later whorls. The first one-half whorl coarsely costate beneath the carina, otherwise smooth except for obsolescent, spiral lines and an almost imperceptible irregular, collabral thickening of the shell. Suture impressed, margined by an impressed line, anal sinus U-shaped with the base slightly nearer the periphery than the suture. Body whorl abruptly constricted to a short, straight neck. Aperture pyriform, outer lip smooth within, unfortunately broken, but growth lines show it to have been produced forward with the edge almost straight until the start of the neck where it swings back sharply. Columella smooth, bent to the right and moderately twisted. The parietal edge curves into the aperture anteriorly and then out again to meet the start of the outer lip.

Remarks.—This assignment is the first occurrence of this genus in the Gulf coast. The shoulder is higher than in other members of the genus, but the smooth whorls, large globose protoconch, initially costate whorl, shape of the sinus, and shape of the outer lip is the same as *Spirotropis* s.s. Three similar genera occurring in the Gulf coast are: *Orthosurcula* Casey, 1904, which has a similar keel but also a prominent collar and a conical multispiral protoconch; *Cochlespira* Casey, 1904, which is represented in the Claibornian by *Cochlespira engonata* Conrad, 1865a, has a similar protoconch, is much more sharply carinated, lacks all axial sculpture, has a notched canal and a narrow false umbilicus; subgenus *Volutapex* n. subgen., of *Surculoma* has a mammilate protoconch with the tip bulbous and asymmetrical, whorls submedially carinate over the entire conch and a different shaped anal sinus. Powell (1966) notes the presence of a columellar fold in *Volutapex* but this is an error. Within the known Claibornian genera *Spirotropis* appears to be near *Volutapex* which suggests a closer relationship than is indicated by their assignment to date in different subfamilies. Grant and Gale (1931, p. 547) have noted the relationship of *Spirotropis* to *Turricula* Schumacher, 1817, a genus to which Harris (1937) and Palmer and Brann (1966), assign *Surculoma* as a subgenus.

Etymology.—Noting the first occurrence of this genus in the Claibornian.

Type information.—Holotype: PRI 30488. Type location: locality 4.

Material examined.—1 specimen, 7 mm length, 2.6 mm width.

Subfamily **CLATHURELLINAE** H. and A. Adams, 1858, p. 654

Genus **EOCYTHARA**, new genus

Type species.—*Eocythara texana,* n. sp.

Generic Diagnosis.—Protoconch of about three and one-quarter whorls, the first one to one and one-quarter smooth, the remainder with fine protractive riblets. Adult sculpture of longitudinal rounded costae, spiral lines and a surface which is minutely imbricated or "frosted". Sinus moderately deep, V-shaped, weakly sinuous near the suture. Aperture long with two callus pads on the interior, marking each end of the sinus. Columella straight, smooth and angled to the left. Outer lip sharp, convex below the middle and with a weak stromboid notch. Basal notch not present or only obscurely so.

Remarks.—This genus is evidently the precursor of *Eoclathurella* Casey, 1904, and many of the Miocene clathurids of which *Pachycythara* Woodring, 1928, and *Pyrgocythara* Woodring, 1928, are representatives, are known from the Caribbean basin and Florida. The genus *Raphitoma* Bellardi, 1847, to which *Eocythara* bears a superficial resemblance, is thinner-shelled, has a shallow sinus and a long tapering canal. Most closely allied to *Eocythara* are the two similar genera *Adelocythara* Woodring, 1928, and *Pachycythara* Woodring, 1928. Both of these genera have smaller protoconchs of up to two and one-half whorls which show a few fine or obscure protractive riblets on the last one-quarter turn. The protoconch of *Eocythara,* in contrast, has the last two to two and one-quarter whorls more prominently sculptured, a much shorter canal, and a deep anal notch margined with strong callus build-up. An incipient stromboid notch is also seen in *Platycythara* Woodring, 1928, while the imbricate or "frosted" surface is a feature also common to *Pachycythara* and *Pyrgocythara.* Dockery (in MacNeil and Dockery, 1984, pp. 216–217) assigns

four species to *Clathurella* Carpenter, 1857, from the Oligocene of Mississippi. This genus is lirate or denticulate on both the labrum and inner lip, has subcarinated whorls, possesses no stromboid notch, has the axial ribs conspicuously weaker on the fasciolar slope, and has a twisted siphonal canal. The type species of *Clathurella* is a solid shell, with a "frosted" or minutely pustulose surface, a condition not noted by Dockery in the Mississippi specimens. The earliest clathurellid known to date from the Gulf coast is *Eoclathurella* Casey, 1904 from the Upper Eocene of Louisiana. Species of this genus are very small, have axial and spiral sculpture of similar strength, but with weaker spirals present on the fasciolar area, and a plicate inner lip. Clathurellids are uncommon but cannot be called rare, numerous specimens having been collected by the author from both the Weches and Cook Mountain formations in Texas; most of them show characters intermediate between the Reklaw forms and the Upper Eocene and Oligocene forms.

Etymology.—The generic name *eo-* (Latin, early), *cythara* (Latin, harp), denotes a probable ancestor of many of the Neogene Cythara stock.

Eocythara texana, new species
Plate 21, figures 9–11

Description.—Shell small; protoconch as in the generic description, whorls about six and one-half. Adult whorls with 10 to 11 rounded sigmoid ribs and crisp spiral lines, three to four on the spire whorls and 15 or more on the body whorl. Basal lines more indistinct, the entire surface of the whorl secondarily covered with minute longitudinal and spiral striae, the intersections forming minute pustules. Aperture long, outer lip sharp and thickened within, sinus broadly V-shaped, occupying most of the shoulder area. Inner lip and columella straight with a few of the spiral lines crossing medially into the aperture. Canal weakly flaring below.

Remarks.—Nothing similar to this is known in the Paleogene of the New World; the frosted surface, smooth canal and labrum and large fasciolar surface free of spiral sculpture will distinguish this species from others. In the Miocene of Jamaica *Adelocythara primolevis* Woodring, 1928 is quite similar on the spire, although as noted above the aperture and canal of species in this genus are different.

Etymology.—The specific name notes the occurrence in Texas.

Type information.—Holotype: PRI 30489; paratypes: PRI 30490–30493. Type locality: locality 20.

Material examined.—140+ specimens, the largest: 6.6 mm length, 2.6 mm width.

Eocythara lineata, new species
Plate 21, figures 18–19

Description.—Shell very small, protoconch of three rounded whorls, rapidly expanding, densely sculptured with fine arcuate riblets, the tip enrolled. Adult whorls rounded with axial ribs and spiral lines, the lines weaker above the mid-section of the whorl, on the body whorl an intermediate stria may occur. Collabral growth lines densely regular and raised, more prominently on later whorls. Aperture narrow, outer lip thin-edged, thickened periodically by the ribs, columella straight or slightly excavate, canal short and slightly emarginate.

Remarks.—The species differs principally from *Eocythara texana* n. sp. in having spiral lines over the entire adult shell, a shorter form and weaker, imbricated, surface ornament, only developing on the second adult whorl. In many ways the species resembles *Raphitoma (Microsurcula) nucleola* Casey, 1904, from the Middle Eocene of Louisiana, the type species of *Microsurcula,* suggesting that the root stocks of *Eocythara* and *Microsurcula* are very close. Species belonging to subgenus *Microsurcula* are more elongate, have carinated whorls, a subsutural collar, a concave shoulder, and on the shoulder, ribs of reverse curvature from that on the body whorl. *R. (M.) nucleola* is atypical of most species assigned to *Microsurcula,* in its short, rounded form, but may still be separated on the basis of the above characters. Another similar species is *Eoclathurella obesula* Casey, 1904, from the Upper Eocene Jackson Group, which has the same type and strength of ribs and spiral lines; this species, however, lacks any trace of "frosting", is strongly lirate or denticulate within the aperture, and has a smaller protoconch that is widely ribbed on the final turn.

Etymology.—The specific name *lineata* (Latin, line), refers to the spiral lines covering the entire adult whorls.

Type information.—Holotype: PRI 30494; paratype: PRI 30495. Type locality: locality 20.

Material examined.—Six specimens, the largest 3.9 mm length.

Genus **VARICOBELA** Casey, 1904, p. 162

Type species.—*Strombus smithii* Aldrich, 1885, by original designation. Red Bluff Oligocene of Mississippi.

Revised description.—Shell of moderate size, thick and inflated, with regularly rounded whorls. Protoconch large, broadly conical, of three or four whorls, initially smooth, the last whorl with a reticulate pattern. Sculpture of narrow, obliquely sigmoid ribs, fine spiral lines, and occasional varices. Aperture half the

length of the shell, oblique; canal short and narrow; inner lip smooth; labrum thickened and smooth.

Remarks.—Dockery (in MacNeil and Dockery, 1984, p. 198) assigns this genus to the Turriculine because of Casey's comparison of the protoconch to that of *Pseudotoma* and Powell's (1969, p. 382) synonymizing that latter genus with *Acamptogenotia* Rovereto, 1899. Powell (1969, p. 143) expresses doubt that the genus is a turrid and considers it better placed in the Buccinoidea. The genus appears to be restricted to the Eocene and Oligocene of the Gulf coast.

Varicobela filum, new species
Plate 21, figures 22–23

Description.—Shell small; whorls six; protoconch of three to three and one-half broadly conical whorls, initially smooth, the last half whorl with gradually developing reticulate sculpture that merges imperceptibly into the adult. Teleoconch whorls with 14 to 17 sigmoid ribs, becoming slightly weaker as they approach the deeply impressed sutures; terminal varix present with usually one or two more on previous whorls; sinus very broad, shallow, situated just below the suture, marginally stronger on earlier whorls. Spiral sculpture of regularly spaced thin lines and an intermediate weaker line between each pair; where the spirals cross the axials the sculpture is nodose; on the spire and above the point of greatest inflation on the body whorl the intermediate lines are centrally placed, on the lower portion of the body whorl the line migrates to a posterior position and on the beak to a central position again. Over-running the major sculpture are exceedingly fine and close-set collabral threads. Aperture elongate, labrum smooth, thickened into the interior beneath the terminal varix; prominent anal notch, margined on the labrum by a weak swelling; columella excavated; callus wash thin, showing some of the underlying spiral lines; canal straight; siphonal fasciole present but very weak.

Remarks.—Two species of *Varicobela* have been described previously, *Varicobela smithii* (Aldrich, 1885), and *Varicobela aldrichi* Dockery, 1984, both from the Oligocene of Mississippi. Both of these are larger, have a straight to coeleoconoidal spire rather than the cyrtoconoid shape of *V. filum,* and lack the close-set collabral threads of *V. filum.* Both macro- and micro-sculpture show much similarity with the two *Eocythara* species described previously and the apertural features are similar, excepting that *V. filum* lacks an anal notch. The lack of an anterior notch, weak sinus, and generally similar sculpture to the *Eocythara* species have caused the assignment here to the Turridae.

Etymology.—The name *filum* (Latin, thread), refers to the micro collabral sculpture.

Type information.—Holotype: PRI 30569; paratype: PRI 33074. Type locality: locality 4.

Material examined.—Six specimens, the largest complete (the holotype), 8.8 mm length.

Subfamily **DAPHNELLINAE** Casey, 1904, p. 126

Genus **RAPHITOMA** Bellardi, 1847, p. 538

Type species.—*Pleurotoma hystrix* Cristofori and Jan, 1832, by subsequent designation (Monterosato, 1875, p. 72). Pliocene of Italy.

Diagnosis.—"Shell of medium size, spire moderately high; whorls rounded, sculpture usually in both directions forming a reticulate pattern of raised lines; aperture varying from two-fifths to a half the length of the shell, ovate, outer lip slightly thickened, with at some growth stages a row of very fine denticulations on the inner lip, lip rounding back posteriorly to a moderately deep, usually not reinforced posterior notch close to the suture, inner lip not thickened, columella usually somewhat flexuous, anterior canal not wide, usually sharply defined but not very short, often notched behind." (Grant and Gale, 1931, p. 609)

Remarks.—Powell (1942, p. 125), who only recognizes *Raphitoma* from the Pliocene to Recent, gives a short discussion on the validity of type species *P. hystrix.* Wenz (1944, p. 1452), who also regards *Surcula* as a subgenus of *Raphitoma,* has it ranging from the Eocene to Recent; Davies (1971, p. 391) gives the Geologic range of *Raphitoma* as Paleocene to Recent. The two Reklaw species possess a multispiral protoconch similar in nature to *P. hystrix* rather than to the modern representative of that species, separated under the name *Raphitoma pseudohystrix* Sykes,1906, which has a paucispiral and globular protoconch.

Subgenus **MICROSURCULA** Casey, 1904, p. 154

Type species.—*Microsurcula nucleola* Casey, 1904, by original designation. Middle Eocene of Louisiana.

Original diagnosis.—"Shell very small, of juvenile aspect. Protoconch relatively large, conical, multispiral, closely-coiled and with about five whorls, initially smooth, the last one to three with fine arcuate longitudinal riblets. The periphery is more or less obtusely swollen, the ribs small and numerous, reduced in size and reversed in curvature on the broad fasciolar surface, generally attaining the suture or small subsutural collar above. The canal is rather tapering in form, straight, moderate in length, and together with the aperture about half as long as the shell." (Casey, 1904, p. 154)

Raphitoma (Microsurcula) georgei reklawensis, new subspecies
Plate 22, figures 1–2

Description.—This subspecies is more elongate than *R. (M.) georgei* s.s., has a subsutural collar, and an almost medial carination of the whorls. On the shoulder of the body whorl are spiral lines that alternate in size, and the protoconch is coarsely ribbed.

Remarks.—*Raphitoma (Microsurcula) georgei* (Harris, 1899) is from the Lower Eocene Hatchetigbee Formation of Alabama.

Etymology.—The subspecific name notes the occurrence in the Reklaw Formation.

Type information.—Holotype: PRI 30496; paratype: PRI 30497. Type locality: locality 20.

Material examined.—Four specimens, the largest: 3.9 mm length, 1.5 mm width.

Raphitoma (Microsurcula) bastropensis, new species
Plate 22, figures 3–4

Description.—Shell very small, solid. Protoconch of about three and one-half whorls, the last whorl with widely spaced riblets. Subsutural collar visible on protoconch and first adult whorl. Surface obscurely opalescent, ornament of 15 to 16 longitudinal ribs per whorl and numerous spiral lines. On the fasciolar surface the lines barely override the axials whereas on the carina and below they do so strongly, forming weak nodes at the intersections. Sinus a shallow U occupying all of the shoulder slope. Aperture quadrilateral, outer lip thin, smooth within. Columella straight, no discernible callus; canal short and slightly twisted.

Remarks.—This species differs from *Raphitoma (Microsurcula) iuventae* n.sp. in its squat form and about two to three more ribs per whorl. The probable descendant is *"Pleurotoma (Bela)" rebeccae* Harris 1895a from the Weches Formation, from which it differs in having a wider form, lack of a subsutural raised line, and wider and more even spiral lines. Harris (1895a, p. 64) originally places *"P. (B.)" rebeccae* under section *Bela* Gray, 1847b, first as a subgenus of *Pleurotoma* and later (Harris 1937, p. 79) as a subgenus of *Raphitoma*. Palmer and Brann (1966, p. 839) reinstate Harris's original placement. According to Powell (1966, p. 97–98), *Bela* has a small protoconch, initially smooth, the last whorl with spiral rows of tubercles; its teleoconch whorls have axial folds that do not cross the shoulder slope, and densely spirally striated whorls. The protoconch, overall whorl sculpture, and sinus make the present placement more likely.

Etymology.—Noting the occurrence in Bastrop County, Texas.

Type information.—Holotype: PRI 30498; paratype: PRI 30499. Type locality: locality 4.

Material examined.—Seven specimens, the largest 4 mm length.

Raphitoma (Microsurcula) iuventae, new species
Plate 22, figures 5–6

Description.—Shell small, fusiform. Whorls six to seven, protoconch bluntly conical of four rounded whorls, the first three smooth and the last with widely spaced, oblique riblets that increase in size and merge without break into the adult longitudinal folds. Adult whorls medially carinated, with an impressed suture which is margined below by a large, rounded line. Spiral lines cover the entire whorls and are a little stronger on the carina. Whorls with eight to nine oblique folds, obsolete on the collar and on the body whorl at the start of the canal. Sinus deeply U-shaped, occupying the entire shoulder slope. Aperture subovate, outer lip thin. Anterior canal long, oblique and slightly rostrate.

Remarks.—On some specimens only the upper portion of the shoulder is smooth and there are strong lines on the lower part, close to an as yet undescribed species from the Middle Claibornian in the Stone City Beds of Texas. The gradual change seen from juvenile to adult sculpture appears to be unique in the *Microsurcula* species, in outline the species otherwise resembles *Raphitoma (Microsurcula) intacta* (Casey, 1903) from the Oligocene of Mississippi; the protoconch and early whorls alone distinguish the two species. The sculpture is also similar to that of a juvenile *Surculoma* but the protoconch is different; in general the aspect is that of a juvenile shell but no larger ones, or even fragments have been found in the Reklaw.

Etymology.—The specific name *iuventae* (Latin, young), refers to the juvenile aspect of the shell.

Type information.—Holotype: PRI 30500; paratypes: PRI 30501–30504. Type locality: locality 20.

Material examined.—51 specimens, the largest: 6.0 mm width, 2.2 mm width.

Superfamily **ARCHITECTONICOIDEA**
Taylor and Sohl, 1962, p. 10

Family **MATHILDIDAE** Dall, 1889c, p. 144

Genus **GEGANIA** Jeffreys, 1884, p. 365

Type species.—*Gegania pinguis* Jeffreys, 1884, by monotypy. Recent from Cape Modego, Eastern Atlantic.

Diagnosis.—Shell small, coeleoconoidal, nucleus blunt, immersed and partially covered. Whorls bluntly carinate, with deeply impressed sutures; sculpture of spiral lines and fine oblique growth-lines. Body whorl larger than the remainder, base inflated. Aperture es-

sentially circular, almost holostomatous, outer lip oblique, columella smooth, straight or feebly concave, inner lip callus partially covering the umbilicus.

Remarks.—The genus ranges from the Upper Cretaceous to Recent.

Gegania antiquata texana (Palmer, 1937)
Plate 10, figures 1–2

Tuba (Littorina) antiquata Conrad. Heilprin, 1891, p. 400.
Tuba antiquata texana Palmer, 1937, p. 92, pl. 9, figs. 8,9; Brann and Kent, 1960, pp. 886–887.
Gegania texana (Palmer). Gardner, 1945, p. 150.
Gegania antiquata texana (Palmer). Palmer and Brann (1966), p. 698.

Original diagnosis.—"Shell large, spire high for the species; whorls six; nucleus typical; sculpture of the post-nuclear whorls consists of four strong primary ribs, the first and fourth smaller than the two middle ribs; two, middle, spiral lines increasing in size making the whorls of the spire bicarinate; three to six, fine thread-like, spiral ribs occur between the primary ribs; all crossed by longitudinal threads which at the intersections form a node; below the strong bicarination of the body whorl nine to eleven, spiral ribs occur to the base; one or more, spiral threads alternate with the primary series." (Palmer, 1937, p. 92)

Remarks.—One small specimen was obtained which appears to be specifically identical to *Gegania antiquata texana* from the Weches Formation of Texas and Mexico. The only differences noted between this specimen and typical *texana* s.s are the more elongated form, finer revolving sculpture and a larger protoconch.

Type information.—Holotype: PRI 2473. Figured specimen: PRI 30550, from locality 4.

Material examined.—One specimen.

Genus **MATHILDA** Semper, 1865, p. 330

Type species.—Turbo quadricarinata Brocchi, 1814, by original designation. Tertiary of northern Italy.

Revised diagnosis.—Shell medium-sized, turrited, slender. Protoconch heterostrophic, not immersed. Sculpture of rounded whorls with strong spiral sculpture and axial threads. Base flat to arched, aperture ovate, entire, basal lip everted. Columella smooth, non-plicate.

Remarks.—The genus ranges from the Upper Cretaceous to Recent.

Mathilda (Mathilda) cf. **retisculpta aldrichi**
Palmer, 1937

Mathilda retisculpta aldrichi Palmer, 1937, p. 87, pl. 9, figs. 11, 14.

Original description.—"Shell medium in size, elongate; nucleus heterostrophic consisting of three whorls, first whorl minute, last whorl enlarged; post nuclear whorls coarsely ornamented with spiral lines and longitudinal ribs, which at their intersections form nodes. There are five spiral ribs on the whorls of the spire and ten spiral ribs on the body whorl. The longitudinal ribs become obscure at about the sixth spiral rib on the body whorl. The remaining spiral ribs on the body whorl are not nodose. The aperture is ovate." (Palmer, 1937, p. 87)

Remarks.—This specimen closely resembles *M. r. aldrichi.* In addition to the four nodose ribs of Palmer's subspecies, the Reklaw specimen has three very small ribs below the suture. On the body whorl of *M. r. aldrichi* the longitudinal ribs are nearly effaced by about the sixth spiral rib while in this species they remain visible and continue as fine threads. Were it not for its elevated mathildid nucleus, *Mathilda retisculpta* (Meyer and Aldrich, 1886) and the subspecies *M. retisculpta aldrichi* would be more readily placed in *Acrocoelum* Cossmann, 1888, which is also in the Mathildidae. A very similar species from the Paris Basin is *Acrocoelum bouryi* Cossmann, 1888.

Type information.—Holotype: PRI 2742; paratype: PRI 2741. Type locality: Orangeburg, South Carolina. Range: McBean Formation. Figured Reklaw specimen: PRI 33104, from locality 4.

Material Examined.—3 specimens, the largest complete: 7.1 mm length, 2.5 mm maximum diameter; one fragment with 4.8 mm maximum diameter.

Mathilda (Mathilda) cf. **claibornensis**
Aldrich, 1887
Plate 10, figure 17

Mathilda claibornensis Aldrich, 1887, p. 83; Palmer, 1937, p. 88, pl. 9, fig. 1 copy Aldrich.
Tuba (Mathilda) claibornensis Aldrich. Aldrich, 1895b, p. 15, pl. 1, fig. 7.

Original description.—"Shell very minute, embryonic whorls three, and placed as usual in the genus, the adult whorls (but three remaining in the type) with three rounded smooth ring-like bands, the intervening spaces having impressed longitudinal lines which do not pass over the bands. Locality: Claiborne Ferruginous Sand. Very rare, but the second species known from this famous deposit." (Aldrich, 1887, p. 83)

Remarks.—Two small fragments were obtained that are doubtfully referred to *M. (M.) claibornensis.* Apparently Palmer (1937, pl. 9, fig. 1) had only the one juvenile shell; the three strong ribs are diagnostic of this species however, and stay relatively constant in strength on succeeding whorls. The species is common at certain levels at the Stone City Member type locality and may reach lengths of 5 mm.

Figured Specimen.—PRI 30415, from locality 20.

Type information.—Holotype: USNM 638864. Type locality: Claiborne Bluff, Alabama River, Monroe County, Alabama.

Material examined.—Two broken specimens, the largest 4.1 mm in width, with only the body whorl and half the previous whorl remaining.

Subgenus **ECHINIMATHILDA** Sohl, 1960, p. 131

Type species.—*Mathilda (Echinimathilda) corona* Sohl, 1960, by original designation. Upper Cretaceous, Ripley and Owl Creek Formations of Mississippi.

Original diagnosis.—"Small- to medium-sized turriculate shells with a partially submerged and deviated protoconch; whorls shouldered; sides rounded; sculpture of nodose to spiny spiral lirae and ribbons; columella lip reflected." (Sohl, 1960, p. 131)

Remarks.—Prior to this report the subgenus was restricted to the Upper Cretaceous.

Mathilda (Echinimathilda?) cribraea, new species
Plate 10, figures 5–7

Description.—Protoconch one and three-quarter to two bulbous whorls, set at an angle of 45° from the shell axis, immersed to a level at the base of the nuclear whorl. Adult sculpture begins abruptly and consists of up to seven shouldered whorls, the shoulder becoming progressively more acute, later whorls with an angle approximating 90°, rounded below. Spire whorls with five to six spiral lines below the shoulder, crossed by numerous weaker longitudinal lines, the intersections of the two forming prominent nodes, body whorl with 10 or 11 spiral lines. On the base of the body whorl the spiral lines continue undiminished, while the longitudinal lines become fine threads. Aperture almost elliptical in shape, outer lip thin, columella lip thickened and slightly reflected.

Remarks.—Under the microscope the sculpture is seen to be a regular and finely cancellated pattern. The nearest Tertiary analogue to this species seems to be *Mathilda retisculpta* (Meyer and Aldrich, 1886) from the Cook Mountain Formation of Mississippi. I have also found the subgenus in the Upper Cretaceous Kemp Clay Formation in Texas. The protoconch in *M. (E.) cribraea* is not immersed to the same degree as the type species of the subgenus. As this is a primary character in the definition of the subgenus this Tertiary species is assigned here with some hesitation; in all other respects it is very close to the type species, *M. (E.) corona.* A few individuals do not show the shoulder carina becoming progressively more acute, but that feature by itself does not seem to warrant further taxonomic separation.

Type information.—Holotype: PRI 30329; paratype: PRI 30330. Type locality: locality 4.

Etymology.—The specific name *cribraea* (Latin, sieve), refers to the mesh-like ornamentation of the whorls.

Material examined.—Thirty specimens, the largest: 4.3 mm in length, 1.8 mm in width.

Subgenus **FIMBRIATELLA** Sacco, 1895, p. 37

Type species.—*Cerithium fimbriatum* Michelotti, 1847, by original designation. Miocene (Tortonian) of northern Italy.

Diagnosis.—Shell small, high; whorls carinate with spiral and axial sculpture, the intersections usually nodose; base flat with spiral threads, margined by a duplex spiral line, aperture oval to subquadrate, base weakly rostrate.

Remarks.—The genus ranges from the Paleocene to Pliocene.

Mathilda (Fimbriatella) iugum, new species
Plate 10, figures 8–9

Description.—Shell small, whorls six and a half, protoconch large, of two and a half smooth heterostrophic whorls set at an angle of about 30° from the shell axis. Spire whorls with four spiral lines, one defining the medial carina and two more, one above and one below quartering the whorls, and a weaker subsutural one; spirals intersected regularly with longitudinal lines that are nodular at their intersections. Base smooth or with obsolete spiral threads, flat, margined by a duplex line; aperture circular, columella concave and slightly thickened.

Remarks.—This species appears to have no close analogs in the Gulf coast Paleogene. To date the subgenus *Fimbriatella* has not been reported outside Europe where it is found from the Paleocene to the Pliocene, although Sohl (1960, p. 129) has remarked on the similarity of several Cretaceous Gulf coast species to this subgenus. Of those species I believe *Mathilda (Mathilda) ripleyana* Wade, 1926 is close enough to the type of subgenus *Fimbriatella* to be placed there. Sacco (1895, pp. 36–38) placed seven species in *Fimbriatella* of which *Mathilda (Fimbriatella) filogranata* Sacco, a *nomen nudum* from the Doderlein collection, is very close to *M. (F.) iugum,* differing primarily in possessing one extra spiral line on the shoulder; the type species of the subgenus *M. (F.) fimbriatum* is a little further removed with its more rounded whorls and prominent quadrate-shaped aperture.

Etymology.—Noting both the creek where it was found and the ridged whorls, *iugum* (Latin: ridge).

Type information.—Holotype: PRI 33080, 2.1 mm length; paratype: PRI 33089. Type locality: locality 4.

Material examined.—Eight specimens, the largest the holotype.

Genus **GLYPTOZARIA** Iredale, 1924, p. 248

Type species.—*Turritella opulenta* Hedley, 1907, by monotypy. Recent off Australia near Sydney.

Diagnosis.—Shell turriculate, whorls moderately rounded, with spiral lines and co-marginal axial ribs. Protoconch heterostrophic. Aperture ovate, with weak gutter.

Remarks.—Iredale defined the genus to draw attention to recent Australian turritellid specimens without a sinus in the outer lip; he also noted the occurrence of a fossil species in the Australian Eocene. Excepting the type, the genus is represented by two Recent species from Australian waters, *Glyptozaria columaria* Cotton and Woods, 1935, and *Glyptozaria euglypta* (Iredale, 1929). Wenz (1939, p. 653) follows Iredale, and places the genus in the Turritellidae, probably without knowledge of the protoconch. Cotton (1959, p. 358) moves it to the Turritellopsinae, a subfamily known to have a deviated but often immersed protoconch. MacPherson and Gabriel (1962, p. 99) place it in the present family, the Mathildidae.

Glyptozaria americana, new species
Plate 10, figures 12–14

Description.—Shell small, eight to ten whorls, protoconch heterostrophic, large, of two and a half smooth whorls, set at an angle of about 45° to the shell axis, junction with teleoconch whorls abrupt, delimited with an oblique rib. Spire whorls rounded, ornamented with six spiral lines, the strength and interlineal distance increasing from the upper to lower suture; the spiral lines crossed by numerous axial threads, forming a regular reticulate pattern, the intersections beaded. Body whorl with ten spiral lines, the sutural one the largest, the four or five basal ones closer together, the axial threads also weaker basally. Aperture ovate, outer lip thin, sometimes lirate within, carinate at the end of every rib; columella thickened, excavated and slightly reflected, slight emargination at the anterior end.

Remarks.—This species is unique in the North American Eocene although the Caribbean species *Mathilda plexita* Dall, 1896b, known from the Oligocene? to the Miocene? of Trinidad and Jamaica, is similar. That species has more prominently inflated whorls, four to six equally spaced spiral lines on the spire, an umbilical chink, and a more circular aperture. The basal spiral lines and concave columella of *M. plexita* probably means this species should also be assigned to *Glyptozaria.* In the North American Eocene, specimens of *Scalina trapaquara* Harris, 1895a that lack the protoconch may superficially resemble *G. americana* but the presence of basal spirals will separate the two. This species really points out the necessity of knowing the character of the protoconch, as without that knowledge the species would almost certainly have been assigned within the Scalidae.

Etymology.—Referring to the first occurrence in North America.

Type information.—Holotype: PRI 33078, 4.8 mm length; paratype: PRI 33079. Type locality: locality 4.

Material examined.—Two specimens, the largest 7.5 mm.

Family **ARCHITECTONICIDAE** Gray, 1850b, p. 64

Genus **PSEUDOMALAXIS** Fisher, 1885, p. 714

Type species.—*Bifrontia zanclaea* (Philippi, 1844a), by monotypy. Recent in the Mediterranean and off the Madeira Islands.

Diagnosis.—Shell planispiral, base weakly concave, whorls only lightly in contact or free, rim flat. Sculpture smooth, or with weak spiral or radial lines. Edge with crenulated cords, usually parallel to the axis but sometimes angulated. Aperture quadrilateral, edge sharp.

Remarks.—The genus ranges from the upper Cretaceous to Recent. Recent species are tropical or subtropical in distribution, and inhabit deeper waters.

Pseudomalaxis reklawensis, new species
Plate 10, figures 18–20

Description.—Shell medium-sized, to seven volutions. Whorls slightly concave on the upper and lower surfaces, the body whorl with vertical sides. Protoconch of about two smooth rounded whorls, the nucleus sunken and visible on the base, a fine cord differentiating it from the adult whorls. Whorls smooth above with prominent prosocline growth lines, suture impressed and bounded above by a large beaded cord, below with a similar cord. The lines of growth start at right angles to the sutures, then curve back at the middle of the whorl. Both upper and lower surfaces show very fine spiral striae. Aperture simple and rounded-quadrate in profile.

Remarks.—The closest species is *Pseudomalaxis texana* (Aldrich, 1911) from the Weches Formation, from which it may be distinguished by the lack of tuberculated rows in the center of the whorls and only a single beaded chord on the periphery. Both *Pseudomalaxis rotella* (Lea, 1833) from the Gosport Sand Formation, and *Pseudomalaxis plummerae* Palmer, 1937, from the Stone City beds are smooth, but are much smaller, without beading, and in the case of *P. plummerae* the final portion of the last whorl is bent

out of the plane of coiling. This species is common in the Reklaw deposits, in contrast to the Weches and Cook Mountain Formations where species belonging to this genus are very rare.

Etymology.—Referring to the Reklaw Formation.

Type information.—Holotype: PRI 30336; paratype: PRI 30337. Type locality: locality 20.

Material examined.—110 specimens, the largest 1.1 mm thickness, 9.0 mm maximum diameter.

Pseudomalaxis? acuta, new species
Plate 10, figures 21–23

Description.—Shell medium in size (outer whorl missing), more robust than *Pseudomalaxis reklawensis* n.sp. Whorls flattened above and sharply concave below, the outer rim at an angle of 45° to the upper surface of the body whorl. The upper surface shows the faintest of revolving striae and has the suture bounded by a thick ribbed cord. The basal surface is smooth and shows radial wrinkles at the suture. The basal suture is bounded by a smaller cord than the one on the upper surface and this cord is margined by a ribbed line, the space between the cord and the line showing a few revolving striae.

Remarks.—This species has affinities with the Lower Eocene species *Pseudomalaxis verrili* (Aldrich, 1886); the latter, however, lacks the beaded ribs bordering the upper and lower edges of the body whorl. Another undescribed *Pseudomalaxis?* species occurs in the Wheelock Member of the Cook Mountain Formation in Texas; that species also has an acutely angled outer whorl, but is otherwise very smooth. None of these species fits very well within *Pseudomalaxis* s.l.; the genus *Mangonuia* Mestayer, 1930, would possibly be a better assignment but more material is first necessary for examination.

Etymology.—The specific name *acuta* (Latin, sharp), refers to the acute angular rim of this species.

Type information.—Holotype: PRI 30291. Type locality: locality 20.

Material examined.—One specimen, 5.1 mm in maximum diameter.

Genus **ARCHITECTONICA** Röding, 1798, p. 78

Type species.—Trochus perspectivus Linnaeus, 1758, by subsequent designation (Gray, 1847, p. 151). Recent in the Indo-Pacific.

Diagnosis.—Shell solid, umbilicate. Outline subdiscoidal to depressed-conic. First whorl of protoconch inverted, only the final smooth inflated volution visible on the apical surface. Whorls numerous, regularly increasing in size. Periphery rounded or carinate. Sculpture usually of spiral cords, which may be beaded. Aperture elliptical to subquadrate. Outer lip thin and sharp.

Remarks.—Recent species are few in number and restricted to warmer waters; the animals are carnivorous on sea anemones and corals. The genus is known from the Upper Cretaceous.

Subgenus **STELLAXIS** Dall 1892, p. 323

Type species.—Solarium alveatum Conrad, 1833a, by original designation. Upper Claibornian Gosport Sand Formation of Alabama.

Diagnosis.—Shell moderately large or large; spire smooth, suture impressed, margined above by a few spiral lines or grooves; keel sharply carinate; beneath smooth or weakly spirally striate, keel margined by a strong line; umbilicus wide, stellate; aperture rounded-rhombohedral.

Remarks.—The subgenus is known from the Paleocene and Eocene of North America.

Architectonica (Stellaxis) reklawensis, new species
Plate 11, figures 1–2

Description.—Shell large, subconical, of seven and three-eighths to eight whorls. Protoconch of one and a half smooth whorls, later whorls smooth and convex below the suture and concave above it, the body whorl acutely carinated. Suture impressed and margined above with two revolving lines, the larger one defining the sutural edge. The first one to two adult whorls with indistinct radial wrinkles below the suture. Base smooth, or with spiral striae, convex near the umbilicus, and concave near the periphery, which is margined by a strong line. The umbilicus has strong radiating lines of growth which form weak folds at the umbilical carina. The interior profile of the whorl is subcylindrical with a posterior excavated area margined by a crenulated revolving line in the upper quarter.

Remarks.—This species is intermediate in position between *Architectonica sylvaerupis* (Harris, 1897a) and *Architectonica alveata* (Conrad, 1833a). *A. sylvaerupis,* a Lower Eocene species from the Hatchetigbee Formation, lacks the ventral line margining the carina and the umbilical margin is wrinkled rather than folded. Specimens of *A. alveata* from the Weches Formation in Texas differ in having more regular and larger radial umbilical folds and a tendency for the subsutural lines to become effaced at an early stage of growth. The Reklaw specimens keep the prominent subsutural lines at all growth stages. A characteristic of the later *A. alveata* group is the line in the center of the cylindrical umbilical area, prominently crenulated in those from the Jackson group; in the Weches specimens the line is in the lower third and in the

Reklaw specimens in the lower fifth. Palmer and Brann (1966, p. 499), separated the Jackson and Weches *A. alveata* specimens into unnamed subspecies. The folds on the first one to two adult whorls and the smooth upper surface are a characteristic of subgenus *Psilaxsis* Woodring, 1928, but the base lacks the channel margining the umbilical tubercles.

Etymology.—The specific name refers to the formation where the species is found.

Type information.—Holotype: PRI 30339; paratype: PRI 30340. Type locality: locality 20.

Material examined.—17 specimens, the largest (incomplete), 10.0 mm height, 28.6 mm maximum diameter.

Subgenus **PATULAXIS** Dall, 1892, p. 323

Type species.—Solarium scrobiculatum Conrad, 1833b, by original designation. Eocene, Upper Claibornian Gosport Sand Formation of Alabama.

Diagnosis.—Shell dorsally flattened, with funnel-shaped umbilicus and no umbilical rib, umbilical carina with tubercles; radial and spiral sculpture usually feeble or obsolete; periphery sharp, thin; suture usually crenulated.

Remarks.—The subgenus is known from the Upper Cretaceous to Eocene.

Architectonica (Patulaxis?) fimbriaea, new species
Plate 11, figures 3–5

Description.—Shell moderately elevated, flattened at the apex, the early whorls flat and depressed below the crenulated sutures. Later whorls increasingly flush with the suture, slightly sinuous in profile. Suture impressed, margined above by a broad elevated band which is regularly radially ribbed, above that a smaller revolving line and above that another larger crenulated one. The remaining surface covered with smaller flattened lines that are weakly noded where crossed by the sinuous growth lines, the growth lines increasing in size towards the suture above forming strong wrinkles, the intermediate subsutural line usually larger again. Base with concave body whorl, two spiral lines margining the crenulated periphery and many weaker ones that decrease in size with distance from the keel. Umbilicus wide, margin noded, whorls convex within. Aperture rounded rhombohedral.

Remarks.—The concave whorls, at least twice as wide as high, the ribbed cord under the suture and the smooth concave keel place this species in subgenus *Patulaxis.* The shape is between that of *Architectonica scrobiculata* and *Architectonica scrobiculata hicoria* Palmer, 1937, both from the Cook Mountain Formation. *A. scrobiculata* is more elevated, smooth or almost so, and the sutural lines are developed as swellings. The coarse noded sculpture is distinctive and will distinguish the new species from the two latter species. Palmer (1937, p. 171) noted *Patulaxis* is represented in the Arrialoor Cretaceous of India with *Solarium arctense* Stoliczka, 1868; *A. (P.?) fimbriaea* is closer to the Indian species than to *A. scrobiculata* and its varieties.

Etymology.—The specific name *fimbriaea* (Latin, fringe), refers to the radial wrinkles fringing the suture.

Type information.—Holotype: PRI 30341. Type locality: locality 20.

Material examined.—Three specimens, the largest: 8.0 mm width, 16.2 mm maximum diameter.

Subgenus **GRANOSOLARIUM** Sacco, 1892, p. 59

Type species.—Solarium millegranum Lamarck, 1822, by original designation. Middle and Upper Miocene of the Piedmont of Italy.

Diagnosis.—Shell with upper portion of whorl convex, lower part concave, peripheral keel sharp. Dorsal surface ornamented by beaded spiral lines of various strengths. Ventrally ornamented with spiral lines, excavated in front of the keel; umbilicus large, margin with nodes or coarse crenulations.

Remarks.—The subgenus ranges from the Upper Cretaceous to Recent.

Architectonica (Granosolarium) aldrichi caterva, new subspecies
Plate 11, figures 6–8

Description.—This species is similar enough to *Architectonica (Granosolarium) aldrichi* (Dall, 1892) from the Middle Eocene Weches Formation to be regarded as a subspecies, but is distinguished by its generally coarser sculpture. The basal ornamentation of three revolving spiral ribs and two lines of strong umbilical tubercles is similar to *A. (G.) aldrichi,* except that in the Reklaw material the inner row of tubercles is larger than the outer one and less numerous, in a ratio of about 1:3. Instead of three broad flat spirals and three threads margining the umbilical carina there are four broad flat spirals, the innermost one being the largest. On the upper surface the spiral lines are broader and become smooth on the body whorl, but the number of lines is the same as in *A. (G.) aldrichi* s.s.

Etymology.—The subspecific name *caterva* (Latin, crowd), refers to the crowded character of the spiral lines.

Type information.—Holotype: PRI 30338. Type locality: locality 20.

Material examined.—17 specimens, the largest 3.4 mm thickness, 7.1 mm maximum diameter.

Architectonica (Granosolarium) geminicostata, new species
Plate 11, figures 9–10

Description.—Shell medium sized, of six and three-quarters whorls, cyrtoconoid in shape and acute on the margin. The whorls of the upper surface are weakly sinuous in profile, the concavity above the suture with two strong lines and the larger whorls developing a weaker intermediate line and generally with four to five smaller lines above that. Early whorls strongly beaded, the beading tending to become obsolete on the body whorl in large specimens. Area between the lines with regular microscopic oblique striae visible only under the microscope. Keel defined by a strong line. Base excavated near the margin and crossed by spiral lines that increase in strength towards the umbilicus, the final three generally crenulated, the area within the umbilicus showing two further crenulated ribs, the three ribs dividing the whorl area into thirds. Lines of growth within the umbilicus nearly vertical to the uppermost rib where they then swing obliquely forward.

Remarks.—*A. (G.) geminicostata* resembles the middle Claibornian representative, *Architectonica (Granosolarium) meekana* Gabb, 1860 from the Stone City beds and the Cook Mountain Formation; both species are quite variable in form. On some specimens the lines on the upper surface coalesce to form a broad band; spiral striae or thin lines may appear on both upper and basal surfaces; the strengths of the various lines may vary considerably within the group. Characters which are constant are the three lines on the base under the suture and the two crenulated ribs within the umbilicus. This last feature does not seem to be duplicated in any other *Architectonica* sp. within the Claibornian of the Gulf Coastal plain. On the dorsal surface *A. (G.) geminicostata* can be differentiated from *A. (G.) meekana* and subspecies by the more equal-sized spiral lines with the much weaker beading.

Etymology.—The specific name *gemini-* (Latin, twins), *costata* (Latin, rib), refers to the pair of ribs in the umbilicus.

Type information.—Holotype: PRI 30342; paratype: PRI 30343. Type locality: locality 20.

Material examined.—59 specimens, the largest 7.5 mm width, 18.0 mm maximum diameter.

Genus **TRIMALAXIS**, new genus

Type species.—Omalaxis singleyi Aldrich, 1890, herein. Claibornian Eocene of Texas.

Diagnosis.—Shell small to very small, protoconch heterostrophic, ornamented with faint collabral lines, transition to teleoconch as in other Architectonicidae. Teleoconch whorls barely in contact, sutural depression deep, strongly tricarinate with one central peripheral carina, one each on the upper and lower whorl surfaces, intracarinal area smooth or with faint growth lines or threads.

Remarks.—Omalaxis Deshayes, 1830, was defined for a group of shells with multicarinate whorls, basally rounded, the last whorl usually somewhat free and bent out of the plane of coiling. Wenz (1944) places the genus questionably in family Omalaxidae and notes the protoconch was not heterostrophic, unlike that of *Trimalaxis.* Bieler (1984), in his revision of the genus *Pseudomalaxis,* notes that the Eocene species of *Omalaxis* from the Paris Basin have orthostrophic protoconchs, and should be represented by a separate family, the Omalaxidae; the recent species assigned to *Omalaxis* he transfers to *Pseuodomalaxis*; he regards *Omalaxis singleyi* though, as belonging to an undescribed genus in the family Architectonicidae. In the genus *Pseudomalaxis* one other species, *Pseudomalaxis (Spirolaxis) cornuammonis* (Melvill and Standen, 1903), also has a sharp peripheral carina, but in that species the whorls form a wide open spiral and are bent out of the plane of coiling. Recent species of *Spirolaxis* Monterosato, 1913, are differentiated from species of *Pseudomalaxis* s.s, not only by the open whorls but also by their very different operculums. *Trimalaxis* is apparently an offshoot of *Pseudomalaxis* where the teleoconch whorls are derived from the latter by a rotation about the apertural axis by 45°; the remaining teleoconch characters between the two are very similar. The generally close relationship to *Pseudomalaxis* is also noted by the very similar protoconch whorls.

Trimalaxis ora, new species
Plate 11, figures 11–12

Description.—Three and a quarter whorls; nuclear whorls two and a quarter, deviated, initially smooth, gradually developing pronounced riblets. A strong flange ends the nuclear whorls that on the basal surface is folded back over itself. Postnuclear whorls with three strong, square-topped carinal cords overridden by growth lines that regularly increase in size as they approach the outer two carinae and there form nodes at the intersections with the cords. Whorls strongly concave between the peripheral carina and the two adjoining ones, convex on the upper and lower surfaces, in contact at the central carina only. Aperture square-ovate, feebly oblique towards the basal side.

Remarks.—This species is distinguished from *Trimalaxis singleyi* (Aldrich, 1890) by the strongly concave whorl area adjoining the periphery, the smooth peripheral carina, and different apertural shape. The type and all other Middle Claibornian specimens examined have a crenulated peripheral carina. Palmer

and Brann (1966) report only the one species *T. singlei,* from a single location in Lee County, Texas. The author has found the genus to be uncommon but widely distributed in the Cook Mountain and Weches Formations of Texas.

Etymology.—Noting the prominent peripheral rim of this species.

Type information.—Holotype: PRI 30344. Type locality: locality 4.

Material examined.—One specimen, 1.8 mm maximum diameter.

Family **TEREBRIDAE** Mörch, 1852, p. 74

Subfamily **TEREBRINAE** Mörch, 1852, p. 74

Genus **HASTULA** H. and A. Adams, 1853, p. 225

Type species.—Terebra strigillata Linnaeus, 1758, by subsequent designation (Cossmann, 1896b, p. 53). Recent in the Indo-Pacific.

Diagnosis.—Whorls high, smooth; axial crenulations below the suture, or slender ribs not developed into nodes; no spiral sculpture except for a subsutural groove; siphonal fasciole margined by a line; columella simple, straight, produced anteriorly; outer lip sharp, almost straight.

Remarks.—Bratcher and Cernohorsky (1987) monograph the recent Terebridae and conclude, that "It is impossible to devise groupings based on shell characters alone, where there is little or no doubt as to which group a species belongs". They recognize just four genera, including *Hastula.* The closely similar genus *Terebra* Bruguière, 1789, is also found in the Eocene. *Terebra* can be separated by its usually larger size, relatively small last whorl, columella not elongated, aperture squarish-ovate, and sculpture often with strong spiral and/or axial riblets. The genus ranges from the Eocene to Recent.

Subgenus **HASTULA** s.s.

Hastula (Hastula) milamensis, new species
Plate 22, figures 7–8

Description.—Shell very small, high, of eight and one-half whorls. Protoconch of four whorls with the suture margined above and below by a faint line, first three and three-quarter whorls rounded, the last cylindrical and of smaller diameter than the preceding. Adult whorls with a swollen subsutural band, excavated below and with subsutural folds that tend to be nodose below the suture, the folds stronger on early whorls. Columella smooth and straight on the midsection, anteriorly twisted and with a shallow notch. Siphonal fasciole indistinct and margined by a line or groove.

Remarks.—This is close to *Hastula houstonia* (Harris, 1895a) from the Cook Mountain Formation, differing from it by the straighter whorls, much weaker ornamentation and the larger more conical protoconch. The body whorl is also noticeably more rounded than on the Reklaw species.

Etymology.—The specific name notes the occurrence in Milam County, Texas.

Type information.—Holotype: PRI 30506; paratype: PRI 30507, 30508. Type locality: locality 20.

Material examined.—115 specimens, the largest: 8.3 mm length, 2.1 mm width.

Subgenus **BULBIHASTULA,** new subgenus

Type species.—Hastula (Bulbihastula) ampulla.

Diagnosis.—Whorls weakly to moderately convex, broadly excavated below the suture, no subsutural spiral band. Ornament of prominent, longitudinal folds and little or no spiral ornament. Aperture a little longer than in *Hastula* s.s. and with a weak siphonal fasciole margined by a line, no columellar folds, anterior end feebly notched.

Remarks.—This subgenus would appear to include species such as: *Terebra (Myurella) basterot* Nyst, 1843, several subspecies of *Hastula striata* (Basterot, 1825), *Hastula benoisti* (Peyrot, 1932), and a common but so far undescribed species from the Cook Mountain Formation in Texas. On the above basis the subgenus would range from the Eocene to the Mocene.

Hastula (Bulbihastula) ampulla, new species
Plate 22, figures 9–10

Description.—Whorls eight to nine, protoconch conical, of three and one-half smooth whorls, slightly heterostrophic, the height and greatest diameter equal. Whorls moderately inflated, with 15 to 21 longitudinal ribs that run the entire length of the whorl, and tend to become nodose above the subsutural excavation. Columella excavated above and bent towards the short, wide canal. Anterior notch very shallow.

Remarks.—Specimens of *Terebra (Myurella) basterot* Nyst, 1843, from the Miocene of northern Italy, which were examined at the Natural History Museum, London are similar, have a different protoconch, but the same number of very laterally compressed straight whorls, and a subsutural line not crossing the ribs. The subsutural line is absent or obsolete in the Reklaw specimens but the type of sculpture and apertural shape are very similar. There appear to be no North American species close enough for a meaningful comparison.

Etymology.—The specific name *ampulla* (Latin, vase), refers to the shape of the body whorl.

Type information.—Holotype: PRI 30509; paratypes: PRI 30510–30513. Type locality: locality 20.

Material examined.—130+ specimens, the largest: 8.0 mm length, 2.7 mm width.

Hastula (Bulbihastula) longifera, new species
Plate 22, figures 11–12

Description.—Shell long, narrow, of nine and one-half slightly convex whorls, subsutural excavation slight to non-existent. Protoconch of three and one-half smooth whorls, higher than wide, nucleus minute and heterostrophic. Adult ornament of numerous low longitudinal folds becoming obsolete below. Columella smooth, straight posteriorly and somewhat abruptly bent below. Anterior notch very small and shallow.

Remarks.—This species can be separated from *Hastula (Bulbihastula) ampulla* by its almost straight sided whorls, and more numerous axial riblets, which become weaker on the lower portion of the whorls. Another similar species is *"Hastula" venusta* (Lea, 1833), which is shorter, has minute spiral striae between the ribs, and a more oblique columella.

Etymology.—The name *longifera* (Latin, lines), refers to the longitudinal ribs on the whorls.

Type information.—Holotype: PRI 30514; paratypes: PRI 30515, 30516. Type locality: locality 20.

Material examined.—13 specimens, the largest: 9.7 mm length, 2.2 mm width.

Subclass **EUTHYNEURA** Spengel, 1881, p. 372

Order **CEPHALASPIDEA** Fisher, 1883, p. 550

Superfamily **CYLICHNIDOIDEA** H. and A. Adams, 1854, p. 9

Family **CYLICHNIDAE** H. and A. Adams, 1854, p. 9

Genus **MNESTIA** H. and A. Adams, 1854, p. 10

Type species.—*Bulla marmorata* A. Adams, 1849, by subsequent designation (Cossmann, 1895, p. 99). Recent in the Philippines.

Diagnosis.—Shell ovately cylindrical, transversely striated, the lines stronger, and wider apart at the ends; spire conspicuous, immersed in the deep umbilicus at the apex; aperture narrow, acuminately produced, both above and below; outer lip solid; columella short, concave, and reflected against the basal whorl.

Remarks.—The genus ranges from the Eocene to Recent.

Mnestia rotunda, new species
Plate 22, figures 17–18

Description.—Shell small, thin. Shape oval, smoothly rounded above and below, body whorl below the apex minutely truncate. Surface with spiral striae on the base and a few on the apical end. Umbilicus small and partially obscured by the outer lip, which thickens ridge-like at the edge as it meets the columella. Aperture thin above and medially, wider below and bent prominently to the left.

Remarks.—Easily separated from other forms due to its more rounded form; far nearer to the type of the genus than are any of the other American Eocene representatives. The common species, *Mnestia dekayi* (Lea, 1833) from the Cook Mountain Formation, is conical, tapering posteriorly. This occurrence extends the lower range of the genus to the Reklaw Formation from the Cook Mountain Formation.

Etymology.—The name *rotunda* (Latin, globular), notes the very inflated form of this species.

Type information.—Holotype: PRI 30517; paratype: PRI 30518. Type locality: locality 20.

Material examined.—19 specimens, the largest: 2.6 mm length, 1.1 mm width.

Mnestia confusa, new species
Plate 22, figures 13–14

Description.—Shell very small, asymmetrically elliptical or ovate, maximum diameter submedial. Aperture curved, wider below and bent to the left both above and below, slightly reflected below. Outer lip smoothly curved below, straightening out above, except for a slight thickening where its meets the anterior portion of the margin at the lower umbilicus. Surface smooth with faint spiral lines on the base of the body whorl and fainter ones below the apex, medial area with microscopic longitudinal lines of growth.

Remarks.—This species approaches *Bulla* s.s. in shape, particularly the recent *Bulla eburnea* Dall, 1881, of Florida and the West Indies. It can be distinguished from *Mnestia rotunda* n.sp. by its shorter and more globose shape and the asymmetrical shape of the body whorl. The species also has characteristics of the genus *Abderospira* Dall, 1896a, in the apertural shape.

Etymology.—The specific name *confusa* (Latin, confused), refers to the resemblance to genus *Bulla.*

Type information.—Holotype: PRI 30519. Type locality: locality 4.

Material examined.—24 specimens: the largest 2.5 mm length, 0.8 mm width.

Family **RETUSIDAE** Thiele, 1925, p. 106

Genus **VOLVULELLA** Newton, 1891, p. 268

Type species.—*Bulla acuminata* Bruguière, 1792, by subsequent designation (A. Adams, 1862). Recent, European seas.

Revised diagnosis.—Shells small, tapering, ovate or subcylindrical; aperture narrow, elongate, rounded basally and extending the entire length of the shell. There is no columellar lamella or other apertural dentition. At its apical end the aperture bends over the apex of

the shell, and the parietal wall here forms a spine which completely covers the apex, so that only the final whorl is visible (after Harry, 1967, p. 134).

Remarks.—Palmer (1937, pp. 492–495) recognizes seven species of *Volvulella* from the Claibornian Eocene; these were reassigned to *Rhizorus* Montfort, 1810 by Palmer and Brann (1966). Harry (1967, pp. 133–135) shows that *Rhizorus* cannot be used as a substitute, so *Volvulella* must be reinstated. Montfort's species would appear to apply to shells similar to *Mnestia.* The genus ranges from the Paleocene to Recent.

Volvulella reklawensis, new species
Plate 22, figures 15–16

Description.—Shell small. Anteriorly subconical, straight-sided below the maximum diameter, anterior lip prominently protruding from a rear view. Posterior end drawn out into a channeled spire. Outer lip almost straight medially, thin above, thickening greatly below. Inner lip thickened, reflected partially over the small umbilicus; anterior edge of the outer lip duplex, then splitting, the edges bounding each edge of the umbilicus. Below, the aperture flares widely and forms an incipient fold. Surface medially smooth, with spiral lines on each end and a few short obscure longitudinal lines.

Remarks.—The closest species is *Volvulella loisae* Palmer, 1937, from which it can be separated by the more tapering extremities, and the narrower aperture which is anteriorly bent to the left. Another similar, slender species is *Volvulella conradiana* (Gabb, 1860) which is more cylindrical with a shorter posterior spine. The rotund *Volvulella minutissima* (Gabb, 1860) also exhibits the duplex character of the basal edge but to a far lesser degree. This occurrence extends the lower range of the genus from the Middle to the Lower Claibornian.

Etymology.—The specific name refers to the formation in which it occurs.

Type information.—Holotype: PRI 30520. Type locality: locality 20.

Material examined.—Four specimens, the largest: 2.9 mm length, 1.0 mm width.

Genus **RETUSA** Brown, 1827, pl. 38, figs. 5, 6

Type species.—Retusa crassa Montague, 1803, by original designation. Recent off the coast of Great Britain.

Diagnosis.—Shell small, cylindrical-pyriform, spire low, sunken or involute. Aperture half the total length of the shell, posteriorly narrow, anteriorly flaring. Columellar fold weak to absent. Last whorl smooth, or with fine spiral striae, labrum usually opistocline at suture.

Remarks.—Zilch (1959, p. 45) gives the range of *Retusa* as Jurassic to Recent.

Subgenus **CYLICHNINA** Monterosato, 1884, p. 143

Type species.—Cylichnina laevisculpta, Granata, 1877, by original designation. Recent in the western Mediterranean.

Diagnosis.—Shell small to very small; cylindrical to ovate; spire depressed, previous whorls not visible; body whorl posteriorly rounded, usually anteriorly spirally striate, sometimes entirely so; aperture narrow, long, higher than the apex; columella excavated, usually with a fold.

Remarks.—Palmer (1937, p. 479), Gardner (1945, p. 265), and most authors prior to 1952 regard *Cylichnina* as a subgenus of *Cylichna,* Lovén, 1846. Since Eames (1952), authors have regarded *Cylichnina* as a subgenus of *Retusa.*

Retusa (Cylichnina) notata, new species
Plate 22, figures 19–20

Description.—Shell small, ovate-cylindrical. Surface covered with fine spiral striae which are more prominent on both ends; medially the lines are less conspicuous but double in number due to intermediate striae. Outer lip thin, sharp and almost straight. Inner lip thickened below the small umbilicus, thinning gradually posteriorly and abruptly anteriorly at the junction with the outer lip. Aperture long, slightly constricted at the posterior third of the body whorl, wider below and bent to the left. Under the microscope the thickened labial ridge is seen to have minute transverse lirae on the summit.

Remarks.—This species has close affinities with both *Retusa (Cylichnina) galba* (Conrad, 1833a) and *Retusa (Cylichnina) kellogii* (Gabb, 1860), but can be distinguished from both of the preceding by the more slender outline, the smoothly rounded posterior end rather than the flat top of those species, and the lirate labial ridge. The Sabinian species *Retusa sylvaerupis* (Harris, 1899) is slightly conical, wider than *R. (C.) notata* and has a columellar depression with incipient folds on either side.

Etymology.—The name *notata* (Latin, markings), refers to the spiral lines covering the entire surface of the whorls.

Type information.—Holotype: PRI 30521; paratypes: PRI 30522, 30523. Type locality: locality 20.

Material examined.—Eight specimens: the largest 6 mm length, 1.8 mm width.

Retusa (Cylichnina) cf. **adamski** Palmer, 1937
Plate 22, figures 21–22

Cylichnina adamski Palmer, 1937, p. 482, pl. 75, figs. 22, 23; Brann and Kent, 1960, p. 301; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 20.
Retusa (Cylichnina) adamski Palmer and Brann, 1966, p. 877.

Original description.—"Shell small; perforate; posterior end truncated; sides of the shell nearly parallel; aperture narrow posteriorly; columellar callus has a twist or fold which varies with specimens—on some specimens only a trace is seen—back of the twist is a groove; surface smooth except for a few microscopic spiral lines anteriorly." (Palmer, 1937, p. 482)

Remarks.—The Reklaw specimens are slightly slenderer than typical *R. (C.) adamski* s.s.

Type information.—Holotype: PRI 3388. Figured Reklaw specimen: PRI 30551, from locality 4.

Material examined.—Six Reklaw specimens, numerous Cook Mountain ones.

Family **RINGICULIDAE** Philippi, 1853, p. 190

Genus **RINGICULA** Deshayes, 1838, p. 342

Type species.—Auricula ringens Lamarck, 1804, by subsequent designation (Gray, 1847a, p. 140). Eocene of the Paris Basin.

Revised diagnosis.—Shell small, oval to globose, spire moderate in extent. Protoconch heterostrophic, deviated, nucleus partially immersed. Whorls inflated, ornament usually of punctate spiral striae, suture impressed. Aperture auriform, contracted above, notched basally. Outer lip varicose, dentate; labrum thickened, toothed above; columella with two folds, the lower one defining the basal edge.

Remarks.—The genus ranges from the Upper Cretaceous to the present where it is abundantly represented in temperate and tropical waters, usually at depths of over 50 fathoms. The animals are reported to be carnivorous on polychaete worms and foraminifera.

Ringicula trapaquara Harris, 1895a
Plate 22, figures 23–24

Ringicula trapaquara Harris, 1895a, p. 53, pl. 3, fig. 7; Aldrich, 1897, p. 8, pl. 2, fig. 7; Gardner, 1933, p. 211; Palmer, 1937, p. 476, pl. 73, fig. 8; Palmer and Brann, 1966, p. 884; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 11.

Original description.—"Whorls five; whorls one, two and three nearly or quite smooth; four with a well marked subsutural line and fainter ones over the whorl surface; body whorl striate spirally, labrum very much thickened and crenulate within, labial callosity very pronounced, the labial plicae strong and ascending rapidly over the body whorl." (Harris, 1895a, p. 53)

Remarks.—The Reklaw specimens of *R. trapaquara* s.s. are somewhat thinner shelled, develop the spiral ornament earlier and show less development of callus than *R. trapaquara* s.s from the type locality. The number of spiral lines is the same in specimens from the Cook Mountain Formation and the Reklaw Formation, although in the latter group, the lines are smaller and more regularly spaced. The strength of the spiral ornament appears to be of little importance as a differentiating character in specimens of *R. trapaquara* from the Stone City Member of the Cook Mountain, as the spiral ornament ranges from being quite smooth to strongly striate. Several specimens from Ridge Creek are altogether more elongate, exhibiting more pronounced labial callosity than the remainder and might represent a new species; these specimens came from a thin sandy lens within an area where the clay is quite black, has an almost waxy consistency, and is otherwise quite featurless. No other molluscs were found in this area. Until more specimens are collected it is not known if this represents a distinct group.

Type information.—Holotype: TBEG 35572. Type locality: San Antonio Ferry, Burleson County, Texas. Range: Middle Eocene, Stone City beds. Figured Reklaw specimen: PRI 30524, from locality 14.

Material examined.—34 specimens, the largest: 2.4 mm length.

Family **PHILINIDAE** Gray, 1850b, p. 94

Genus **PHILINE** Ascanius, 1772, p. 331

Type species.—Bulla aperta, Linnaeus, 1767, by monotypy. Recent seas of the British Isles.

Diagnosis.—Shell thin, fragile, loosely enrolled; spire small, often hidden; body whorl smooth or spirally striate, greatly expanded anteriorly; outer lip rounded.

Remarks.—Philine species are carnivorous on small molluscs below the sea bed, usually at moderate depths. The genus ranges from the Upper Cretaceous to Recent.

Philine sp.
Plate 22, figure 25

Remarks.—Two specimens of this genus were obtained; they are very similar to *Philine (Megistostoma) gabbianum* (Stoliczka, 1868) from the Middle Eocene of California. The almost complete example is embedded and somewhat flattened, in a block of matrix hiding the apertural view. The posterior view outline is closely similar to that of *P. (M.) gabbianum,* the surface is smooth with spiral threads, closely spaced near the apex becoming more widely spaced and duplex in character towards the anterior; edge of the outer lip at the apex is thickened. An apical fragment was also

obtained which may represent this species. Two species are reported from the Gulf Coast Eocene, *Philine alabamensis* Aldrich, 1897, from the Sabinian Eocene at Wood's Bluff and *Philine (Megistostoma) dockeryi* Allen, 1970, from the Moody's Branch Upper Eocene of Mississippi; *P. alabamensis* has fine, zigzag spiral lines and *P. (M.) dockeryi* has much stronger spiral sculpture which becomes less crowded towards the apex.

Figured specimen: PRI 30404, from locality 4.

Material examined.—Two specimens, the figured specimen 19 mm length.

Superfamily **ACTEONOIDEA** Cernohorsky, 1972, p. 203

Family **ACTEONIDAE** d'Orbigny, 1842b, p. 106

Genus **ACTEON** Montfort, 1810, p. 314

Type species.—Voluta tornatilis Linnaeus, 1758, by original designation. Recent in European seas.

Diagnosis.—Shell usually small to very small, profile ovate to elliptical in shape. Protoconch usually not entirely visible, the tip enrolled. Whorls rounded, suture impressed, sometimes channeled; sculpture of punctate spiral lines. Aperture long, contracted above, basally expanded and rounded. Outer lip thin, labrum with one fold which is the continuation of the basal edge.

Remarks.—Acteonids are regarded as the most primitive living opisthobranchs; the group is worldwide in distribution in temperate and tropical waters in moderate depths; the animals are carnivorous on polychaete worms. The genus is widely distributed form the Upper Cretaceous to Recent.

Acteon pomilis punctatus I. Lea, 1833
Plate 22, figures 28–29

Acteon punctatus I. Lea, 1833, p. 111, pl. 4, fig. 96; H.C. Lea. 1849, p. 95; de Gregorio 1890, p. 165, pl. 16, fig. 21 copy Meyer, fig. 22 copy Lea; Harris 1895c, p. 37, not *Tornatella punctata* Férussac, 1823 (in: 1819–1832), p. 112 (= *T. sulcata* Gmelin); not d'Orbigny in Sagra (1842c), p. 230.

Acteon punctatus I. Lea. Conrad, 1865a, p. 34; 1866a, p. 9; Meyer, 1885, p. 468; Dall, 1892, p. 14 in part; Cossmann, 1893, p. 48 as *Actoean*; Cossmann, 1895, p. 46.

Acteon inflatior Meyer, 1886, p. 78, pl. 2, fig. 31; Cossmann, 1893, p. 48.

Actaeonida (Rictaxsis) punctatus (I. Lea). Cossmann, 1895, p. 52.

Acteon pomilis punctatus I. Lea. Palmer, 1937, p. 499, pl. 74, figs. 25, 29, 31, 35, 36; pl. 90, fig. 2; Brann and Kent, 1960, p. 24; Palmer and Brann, 1966, p. 482; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 10, p. 28.

Original Description.—"Shell ovately conical, transversely and closely furrowed; furrows closely set with punctures; substance of the shell rather thick; spire rather elevated, pointed; suture somewhat impressed; columella with one fold; whorls five; mouth narrow, about three-fifths the length of the shell; outer lip thickened about the middle. Length 7–20ths, Breadth .2 of an inch." (I. Lea, 1833, p. 111)

Remarks.—The Reklaw specimens appear to differ in very few respects from *A. p. punctatus* as developed in the Stone City and Landrum members of the Cook Mountain Formation. The shell is slightly more elongate, possesses flat-topped ribs and has a weaker, more oblique columellar fold. Even though these differences are constant, they are within the range of variability of the species as exhibited by specimens in the Weches through Gosport Sand formations, and thus not deserving of separate taxonomic rank. Specimens assigned to the species *A. pomilis punctatus* show a steady development of more rounded ribs throughout Claibornian times, a sequence that ends with *Acteon annectens* Meyer, 1885.

Type information.—Holotype: ANSP 5537. Holotype *Acteon inflator* Meyer, 1886: USNM 638840. Type locality: Claiborne Bluff, Alabama river, Gosport Sand Formation. Figured Reklaw specimen: PRI 30525, from locality 4.

Material examined.—30 specimens, the largest: 5.5 mm length, 3.0 width.

Genus **SEMIACTEON** Cossmann, 1889, p. 304

Type species.—Tornatella sphericulus Deshayes, 1864, by original designation. Lutetian Eocene of the Paris Basin.

Original Diagnosis.—"Coquille ombiliquée, globuleuse, à embryon obtus et mamillé, à ouverture entière et arrondie; labre épais, avec un bourrelet obsolète a l'extérieur; columelle droîte, un peu renflée au milieu, se terminant en point à sa jonction avec le bord antérieur. Type: *Tornatella spaericula,* Desh." Translation: Shell umbilicated, inflated; protoconch obtuse and mammilate; aperture entire, rounded; outer lip sharp; with an obsolete callus pad; columella straight, a weak fold in the middle, terminated anteriorly at the base.

Remarks.—The strong collabral lines forming a cancellate ornament and the shorter anteriorly rounded aperture can also be used to distinguish this genus from *Acteon* s.s.. *Semiacteon* has not hitherto been reported outside of Europe where it is represented by a few species ranging from the Eocene to the Miocene. A similar genus is *Kleinacteon* Vokes, 1939, which was placed doubtfully in the Acteonidae by Vokes due to the "smooth, somewhat naticoid" nucleus. MacNeil (in MacNeil and Dockery, 1984, p. 230) places *Kleinacteon* in the Acteonidae, surmising that Vokes may have failed to recognize the obscurely heterostophic nature of the nucleus. If the nucleus is heterostrophic there appears to be no essential difference between *Semiacteon* and *Kleinacteon.*

Semiacteon texanum, new species
Plate 22, figures 26–27

Description.—Shell small, elongate, of about five whorls. Protoconch large, tip enrolled and not visible. Sculpture of fine, flat-topped spiral lines of equal strength, spaced somewhat wider apart on the subsutural ramp, crossed by fine, longitudinal threads forming a cancellate pattern. Where the threads cross the spirals they bend sharply forward so the entire pattern is slightly offset from thread to thread. Aperture elongate-ovate with a slight spout, outer lip sharp, straight at the mid-section, and considerably thickened behind the rim. Columella thickened at the base of the body whorl into an obtuse incipient fold that decreases in strength as it spirals into the aperture. Umbilical chink present.

Remarks.—The sculpture is similar to that of species of *Acteon* s.s. but the latter have wide flat ribs with narrow interstices whose longitudinal threads are only visible within the grooves, thus generating a punctate pattern. The present sculpture, apertural shape and weak fold on the columella assign the species to *Semiacteon.* In the acteonids examined from the Claiborne Group two types of protoconchs occur; the first is smaller, about half the size of the second, having the initial heterostrophic turn rising above the remaining part of the protoconch and forming a blunt conical profile; the second is much larger and has the initial turn fully immersed. I believe these two groups deserve at least subgeneric rank. The paratypes of *A. idoneus* in the Academy of Natural Sciences in Philadelphia, belong to the taxon possessing the second type of protoconch, and indeed is the same type as *Semiacteon (=Kleinacteon).* The most similar species is *Semiacteon puteatus* (MacNeil, 1984) from the Mint Spring Oligocene of Mississippi; that species can be differentiated by the more rounded whorls, thinner spiral ribs, and prominent anterior spout.

Etymology.—The name refers to the occurrence in Texas.

Type information.—Holotype: PRI 33078. Type locality: locality 4.

Material examined.—Two specimens: the largest (the holotype) 4.5 mm length.

Order **ENTOMOTAENIATA** Cossmann, 1896b, p. 5

Superfamily **PYRAMIDELLOIDEA** Gray, 1840, p. 152

Family **PYRAMIDELLIDAE** Gray, 1840, p. 152

Genus **PYRAMIDELLA** Lamarck, 1799, p. 76

Type species.—Trochus dolabratus Linnaeus, 1758, by original designation. Recent off the coast of Florida and the West Indies.

Diagnosis.—Shell elongate-conic, whorls increasing regularly in size; two or three folds on the columella. The shell is usually strongly polished and porcellaneous in luster (after Dall and Bartsch, 1909, p. 8).

Remarks.—The distribution is world wide with many species ectoparasitic or carnivorous on polychaete worms, coelenterates and molluscs. The genus ranges from Paleocene to Recent. As Dall and Bartsch (1904) note, their grouping of the family Pyramidellidae is in many respects only a practical and convenient one. This has led to a somewhat artificial placement of the Reklaw specimens since species described herein often have some characters belonging to more than one subgenus. For convenience, however, their division of the group has been followed. The genus and the subgenera treated here are known throughout the Tertiary and are worldwide in distribution.

Subgenus **SYRNOLA** A. Adams, 1860, p. 405

Type species.—Syrnola gracillima A. Adams, 1860a, by original designation. Recent off the coast of Korea.

Diagnosis.—Shell slender, medium sized; one columellar fold, shell not umbilicated; surface marked by fine lines of growth and microscopic spiral lines, axial sculpture lacking; protoconch heteroscopic, nucleus central, exsert; postnuclear whorls increasing regularly in size.

Pyramidella (Syrnola) pirum, new species
Plate 23, figures 1–2

Description.—Shell small and slender. Whorls 10, protoconch of one and one-half whorls at right angles to the shell axis and partially immersed in the succeeding whorl. Adult whorls smooth, straight-sided or feebly concave below the deeply impressed suture and curving smoothly inward to the lower suture. The strength of the sutural depression varies with age, later whorls being more strongly impressed, generating a prominently rounded lower whorl profile. Body whorl prominently rounded below a slight basal keel, outer lip smooth within, aperture tear-drop shaped, inner lip reflected below and uniting with a basal columellar fold. Small umbilical depression present.

Remarks.—This species most closely approaches *Pyramidella (Cossmannica) perexilis* (Conrad, 1865a), from the Cook Mountain and Gosport Sand formations, but is much smaller and is placed in section *Syrnola* instead of *Cossmannica* due to the lack of a second columellar fold. None of the specimens shows even a trace of a second fold.

Etymology.—The specific name *pirum* (Latin, pear), refers to the pear-shaped aperture.

Type information.—Holotype: PRI 30526; paratypes: PRI 30527, 30528. Type locality: locality 20.

Material examined.—21 specimens, the largest: 3.5 mm length, 0.7 mm width.

Subgenus **COSSMANNICA** Dall and Bartsch, 1904, p. 6

Type species.—Pyramidella clandestina Deshayes, 1861, by original designation. Eocene (Cuisian and Thanetian) of the Paris Basin.

Diagnosis.—Columellar folds two; shell not umbilicated, surface polished, marked by fine lines of growth and microscopic spiral striations; basal fasciole absent; aperture suboval (after Dall and Bartsch, 1909, p. 10).

Remarks.—Dall and Bartsch separated this subgenus from *Syrnola* solely on the basis of the suboval shape of the apertural.

Pyramidella (Cossmannica) perexilis (Conrad, 1865a)
Plate 23, figures 3–4

Obeliscus perexilis Conrad, 1865a, p. 28.
Odostomia perexilis (Conrad). de Gregorio, 1890, p. 157, pl. 15.
Syrnola perexilis (Conrad). Dall, 1892, p. 247.
Pyramidella perexilis (Conrad). Palmer, 1937, p. 75 in part, pl. 7, figs. 4, 5, 21; Palmer and Brann, 1966, p. 869; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 20, 32.

Original description.—"Subulate, polished; volutions fourteen; sides straight above and rounded at base; suture deeply channeled; body whorl with slightly concave sides; columella with a prominent plait uniting with the labial deposit." (Conrad, 1865a, p. 28)

Remarks.—The Reklaw specimens are very close to *P. (C.) perexilis* s.s. from the Middle Claibornian, differing mainly in the less prominent contraction of the body whorl above the suture. They possess a well-defined second fold that starts within the aperture; a few specimens show one to three spiral lirae within the outer lip. An extremely common species in the Reklaw deposits, outnumbering the other *Pyramidella* spp. by at least 10:1.

Type information.—Holotype: ANSP 1567. Type locality: Claiborne Bluff, Monroe County, Alabama. Range lower Claibornian in Texas to upper Claibornian in Alabama. Figured Reklaw specimen: PRI 30529, from locality 20.

Material examined.—197 specimens, the largest: 7.0 mm length, 1.7 mm width.

Pyramidella (Cossmannica) filamentosa, new species
Plate 23, figures 7–8

Description.—Shell small, to ten whorls. Protoconch heterostrophic of one and a half whorls, 50% immersed in the succeeding whorl. Spire conical, whorls straight-sided to feebly excavated medially, and carinated above the impressed suture. Surface polished with fine lines of growth and ultramicroscopic spiral lines. Body whorl angulated medially, smoothly rounded basally. Outer lip sharp and where fractured showing a few lirae internally. Columella with one strong fold with a weaker one below at a more acute angle ending at a labial swelling.

Remarks.—Where most of the labial area has been broken, a microscopic umbilicus may be visible, but since no specimens with a complete labrum show that feature, the species has been assigned to subgenus *Cossmannica,* instead of the umbilicated subgenus *Ulfa.* The characters place this species close to *Pyramidella (Ulfa) chavani* Palmer, 1937, from the McBean and Gosport Sand formations, although that is a stouter species which is umbilicated and has stronger spiral striations on the base.

Etymology.—The specific name *filamentosa* (Latin, filament), refers to the microscopic spiral lines on the surface.

Type information.—Holotype: PRI 30530; paratypes: PRI 30531–30534. Type locality: locality 20.

Material examined.—27 specimens, the largest: 4.4 mm length, 1.1 mm width.

Pyramidella (Cossmannica) tundrae, new species
Plate 23, figures 5–6

Description.—Shell small, whorls 12, spire cyrtoconoid and usually somewhat bent near the posterior end. Protoconch of one and one-quarter to one and one-half heterostrophic whorls, 50% immersed in the succeeding whorl. Adult whorls straight-sided to excavated, polished, and with a narrow shoulder giving the whorls a stepped appearance. Aperture ovate, outer lip thin and with a few lirae within, columella with one large fold and a small one anteriorly. Inner lip strongly reflected, umbilicus minute to closed.

Remarks.—This is a very variable species, particularly with regard to the size of the shoulder and the subsutural angulation. Some specimens have an almost smooth profile while others are prominently stepped. A few specimens have the whorls stepped to such a degree as to give the appearance of a medial furrow. A characteristic feature is the rounded and bent spire. *Pyramidella (Longchaeus) larvata* Conrad, 1833b, a similar species from the Gosport Sand, has a larger spiral angle, straight to convex whorls, and more prominently impressed sutures. Even though the lectotype of *P. (L.) larvata* is uniplicate, Palmer (1937, p. 72) places the species in *Longchaeus,* because other specimens do show three columellar plicae, although two of them very weakly. One specimen shows the

second fold weakly duplex but as the remaining characters are the same the species is left in *Cossmannica*.

Etymology.—Referring to the smooth, featureless character of the whorls.

Type information.—Holotype: PRI 30405; paratypes: PRI 30439–30412. Type locality locality 20.

Material examined.—95 specimens, the largest (the holotype) 5.2 mm length.

Pyramidella (Cossmannica) tundrae zigguratum, new subspecies
Plate 23, figures 9–10

Description.—Shell very small, whorls six, cyrtoconoid, solid. Protoconch largely immersed, nucleus not visible. Adult whorls smooth or with ultra-microscopic spiral striae, shouldered and moderately excavated medially. Body whorl moderately expanded basally, below that gently carinate. Aperture subquadrate; columella sturdy, straight with two folds, the upper one strong, the lower much weaker and at a greater angle to the axis.

Remarks.—The strongly cyrtoconoid profile and stepped concave whorls seem unique to the Pyramidellidae. The most closely related species is *P. (C.) tundrae* s.s., from which it differs by an accentuation of the concave sides of the whorls, more prominently stepped whorls and the carinate body whorl. Some specimens of *P. (C.) tundrae* do approach these but no intermediate examples connecting them were found.

Etymology.—Noting the resemblance to a ziggurat with the stepped sides.

Type information.—Holotype: PRI 30479. Type locality: locality 4.

Material examined.—Four specimens, the largest: 1.2 mm length.

Genus **ODOSTOMIA** Fleming, 1817, p. 76

Type species.—Turbo plicatus Montague, 1803, by subsequent designation (Gray, 1847a, p. 159). Recent off the British Isles.

Diagnosis.—Shell small to very small, high, conical. Protoconch low, considerably immersed. Whorls usually smooth, occasionally with spiral sculpture. Aperture not holostomatous; labrum sometimes lirate; columella concave with one strong fold. Sometimes umbilicated.

Remarks.—The genus is known from the Upper Cretaceous to Recent.

Subgenus **DOLIELLA** Monterosato, 1880, p. 73

Type species.—Odostomia (Doliella) nitens Jeffreys, 1870, by subsequent designation (Dall and Bartsch, 1909, p. 15). Recent in the Mediterranean off Sicily.

Diagnosis.—Postnuclear whorls sculptured similarly throughout, no varices present, shell polished with no axial sculpture, spiral sculpture consisting of a more or less conspicuous spiral ridge.

Remarks.—The subgenus ranges from the Eocene to Recent.

Odostomia (Doliella?) ova, new species
Plate 23, figures 11–12

Description.—Whorls five and a half, nucleus globose, the tip immersed. Whorls straight-sided with a slightly swollen subsutural ridge. Suture impressed. Body whorl basally carinated; below the carina sloping in a straight line to the anterior part of the aperture. One strong columellar fold, outer lip usually lirate within but not extending to the edge; umbilicus small and partly covered by the inner lip.

Remarks.—This species seems to be unique in the Claibornian. The closest described species is perhaps *Odostomia (Evalea) melanella* (Lea, 1833), from the McBean and Gosport Sand formations, with which it shares smooth outer whorls, microscopic striations, and lirations within the outer lip that die out before the edge. The Reklaw species is much smaller, more elongate, more prominently carinate at the base of the body whorl, and has a swollen subsutural ridge.

Etymology.—Noting the ovate apertural shape.

Type information.—Holotype: PRI 30536; paratype: PRI 30537. Type locality: locality 4.

Material examined.—25 specimens, the largest: 2.5 mm length.

Odostomia spp.

Remarks.—At least two other species of *Odostomia* appear to be present, all very small in size and may be juvenile; the largest is about 1 mm in length. The most common species seems assignable to subgenus *Heida* Dall and Bartsch, 1904; it shows a continuous peristome, an almost channeled base and no apparent sculpture. The only Tertiary species showing any similarity is *Odostomia (Odostomia) aff. angularis* Dall and Bartsch, 1904.

Material examined.—13 specimens, the largest: 1 mm length.

Subfamily **TURBONILLINAE** Bronn, 1849

Genus **TURBONILLA** Risso, 1826, p. 224

Type species.—Turbonilla plicatula Risso, 1826, by subsequent designation (Dall and Bartsch, 1903, p. 269). Pliocene of Italy.

Revised diagnosis.—Shell very elevated, with prominent longitudinal ribs, sometimes also with spiral ornamentation; suture strongly impressed; aperture rounded-rhombohedral; columella with a single low

plication which is either not visible, or is only just visible within the aperture. Protoconch heterostrophic, considerably elevated.

Remarks.—The genus is known from the Eocene to Recent.

Turbonilla cf. **neglecta** Meyer
Plate 23, figure 18

Turbonilla neglecta Meyer, 1886, p. 69, pl. 1, figs. 4, 4a; de Gregorio, 1890, p. 159, pl. 15, figs. 31, 32 copy Meyer; Cossmann, 1893, p. 24; 1912, p. 279; Palmer, 1937, p. 81, pl. 8, figs. 4, 11, copies Meyer; Palmer and Brann, 1966, p. 973; Knight, Hodgkinson, Knight, Reid, Lindveit, Lindveit, and Offeman, 1977, p. 33.

Original description.–"Subulate; whorls flattened, closely covered with broad and distinct transverse ribs, ending rather abruptly on the last whorl and leaving the base smooth; aperture subquadrilangular, longer than broad; inner lip twisted, thus forming an obtuse fold at some distance from the sharp outer lip; crenulate within by a few distant elevated spiral lines." (Meyer, 1886, p. 69)

Remarks.—Several broken specimens that can provisionally be assigned to *T. neglecta* were obtained. One specimen shows the inner lip extended tongue-like to the left of the columella, a feature only poorly displayed by Meyer's figure of the species. At least three separate axially costate *Turbonilla* species exist in the Claibornian and would need a thorough revision to place them correctly. Unfortunately Meyer's holotype is lost, *fide* Palmer (1937, p. 81).

Type information.—Syntypes: USNM 638821, 638822. Figured Reklaw specimen: PRI 30540, from locality 4.

Material examined.—Two specimens, the largest: 1.7 mm length.

Subgenus **PTYCHEULIMELLA** Sacco, 1892, p. 59

Type species.—*Tornatella pyramidata* Deshayes, 1833a, by original designation. Recent in the eastern Mediterranean.

Original diagnosis.—"Testa turrito-pyramidata. Anfractus planulati, ultimus saepe plus minusque subangulatus. Apertura ovato-quadrangula vel rhomboidis. Columella supernae, depressae, transverse uniplicata." (Sacco, 1892, p. 59) Translation: Shell turrited; whorls smooth, the last whorl often more or less angulated; aperture ovate-quadrilateral or rhomboidal; columella excavated, one oblique fold.

Remarks.—Dall and Bartsch (1904), in their synopsis of the genus, also noted the presence of at most, microscopic spiral sculpture, the absence of a basal keel and the presence of feeble axial ribs on the early whorls. Wenz (1939) places *Ptycheulimella* under *Eulimella,* Gray, 1847a. The genus is known from the Eocene to Recent.

Turbonilla (Ptycheulimella) meta, new species
Plate 23, figures 13–15

Description.—Shell small, whorls 13. Protoconch of two and a half smooth whorls, strongly heterostrophic with the angle of inclination at ca. 120° and projecting well outside the profile of the spire. First three adult whorls with numerous, faint, backward curving riblets, more prominent posteriorly. Whorls polished and on post-ribbed stage straight-sided and excavated below the deeply impressed suture. The surface shows faint lines of growth that are occasionally developed into obsolete swellings. Aperture trapezoidal, labrum smooth, columella with one strong fold at the base; umbilical depression present.

Remarks.—This species has affinities with *Turbonilla (Ptycheulimella) clinensis* (Aldrich, 1921) from the Lower Eocene of Gregg's Landing, Alabama, but that is an altogether stouter species with a rounded spire and the columellar fold placed nearer the base.

Etymology.—The specific name *meta* (Latin, target), refers to the nuclear whorls jutting outside the axial profile of the later whorls.

Type information.—Holotype: PRI 30541; paratypes: PRI 30542–30545. Type locality: locality 20.

Material examined.—65 specimens, the largest: 4.5 mm length, 1.0 mm width.

Subgenus **PYRGISCUS** Philippi, 1841, p. 50

Type species.—*Melania rufa* Philippi, 1836, by original designation. Recent, Gulf of Gascoyne in the Mediterranean.

Diagnosis.—Shell without a basal keel; spiral sculpture always present, whose strength is stronger than microscopic in character. Whorls not strongly shouldered.

Remarks.—The subgenus ranges from the Eocene to Recent.

Turbonilla (Pyrgiscus) sp.
Plate 23, figures 16–17

Remarks.—One small fragment was obtained of a turrited shell that is similar to *Turbonilla (Pyrgiscus) agrestis* (Aldrich, 1911), from the Lower Eocene Hatchetigbee Formation. The present specimen has one spiral line per whorl less than *T. (P.) agrestis* and there is a tendency for the lines to become nodular where they cross over the axial folds.

Type information.—Figured specimen: PRI 30480, from locality 20.

Material examined.—One specimen, 2.0 mm length.

Order **NOTASPIDEA** Fisher, 1883, p. 571

Superfamily **UMBRACULOIDEA** Odhner, 1939, p. 13

Family **UMBRACULIDAE** Dall, 1889c, p. 88

Genus **UMBRACULUM** Schumacher, 1817, p. 177

Type species.—Umbrella chinensis Martini, 1784 (= *Patella sinica* Gmelin, 1791 by monotypy). Recent, seas off China.

Diagnosis.—Shell moderate to large, ovate; surface with concentric growth lines and sometimes also radial lines; protoconch small, almost central, dextral; interior with radial lines from the apex to the concentric muscle scar.

Remarks.—In the fossil state the closely similar genus *Tylodina* Rafinesque, 1814, can be distinguished by its sinistrally coiled nucleus. *Umbraculum* is known from the Eocene to Recent.

Umbraculum tomaculum, new species
Plate 23, figures 25–26

Description.—Shell medium-sized, ovate in outline, low-conical in profile. Protoconch anterior to the longitudinal midsection, dextral, with a bulbous nucleus followed by about one-eighth of a turn that is set asymmetrically on the adult shell at an angle of about 22° to the longitudinal axis. Apex central, sculpture of numerous fine, radial, flattened lines and comarginal growth resting stages; the entire ornament very subdued. Inner surface porcellaneous and smooth with a few faint radial undulations. Muscle scar very faint except posteriorly, obsolescent towards the anterior (broken) end.

Remarks.—Palmer and Brann (1966, p. 1010) list three *Umbraculum* species from the Lower Eocene Hatchetigbee, Lisbon, and Upper Eocene Moody's Branch formations. The genus is probably much more common than indicated but the flat circular shell does not favour its preservation. I have specimens from the the Weches and Cook Mountain formations, which are all fairly similar and also are similar to the common Jackson *Umbraculum planulatum* (Conrad, 1854). These species are almost entirely concentrically sculptured, have a well-defined entire muscle scar, and when preserved show a closely coiled protoconch. The Reklaw species is higher, primarily radially sculptured on the dorsal surface, and on the holotype shows a somewhat elongated "sausage like" protoconch lying on the surface with the apical end apparently dextrally coiled. A possibly related species is *Eosinica elevata* (Aldrich, 1903), from the Lower Eocene Sabinian Stage; Zilch (1959, p. 60) places *Eosinica* doubtfully in the Umbraculidae (questionably in the Patellidae). *Eosinica elevata* is moderately high, primarily radially sculptured, and has a smooth interior and a crenulated margin. *Eosinica* also occurs in the Cook Mountain Formation, Erickson (1982) described an *Acmaea* (?) sp. nov. 1, which almost certainly belongs to this genus although the protoconch is missing; *Acmaea* has an inflated, non-spiral protoconch.

Etymology.—Noting the protoconch shape.

Type information.—Holotype: PRI 33075; paratype: PRI 33077. Type locality: locality 21.

Material examined.—Two specimens, the holotype 12.7 mm actual length, 13.5 mm width. Estimating from previous growth lines, the unbroken length would be almost 18 mm.

Class **CEPHALOPODA** Cuvier, 1797, p. 378

Subclass **COLEOIDEA** Bather, 1888, p. 302

Order **SEPIIDA** Zittel, 1895, p. 445

Suborder **MYOPSINA** d'Orbigny, 1839, p. 220

Family **SEPIIDAE** Kerferstein, 1866, p. 1441

Subfamily **BELOSAEPIINAE** Naef, 1921, p. 536

Genus **BELOSAEPIA** Voltz, 1830, p. 23

Type species.—Beloptera sepioidea Blainville, 1825, by original designation. Eocene of France.

Diagnosis.—Phragmocone bent, semiconical, laterally flattened; exterior dorsally coarsely granular; interior smooth with transverse laminae, an elliptical ventral siphuncle, terminating in a solid beak bent in the dorsal direction; dorsal base of beak expanded into an elevated callus, ventral base of beak connected to a semicircular plate expanded posteriorly over part of the rostrum, and anteriorly connecting to the lateral margins of the shell.

Remarks.—The genus ranges from the Paleocene to the Upper Eocene and is cosmopolitan in distribution.

Belosaepia penna, new species
Plate 23, figures 27–28

Description.—Shell rounded, beak bent sharply forward almost at a 90° angle, lip lost. Ventral plate thin, wide and winglike, bent upward at the ends and with longitudinal ridges in groups of five or six on the upper surface and terminating in a crenate edge; below with shorter and more prominent ridges, every fifth or sixth one larger. Dorsal surface under the tip roughly rugose, and with large pimples; the remainder of the dorsal surface finely rugose. Cavity with worn chamber outlines, initially round, then greatly expanding lateroventrally; anterior upper inside surface flattened with the upper and lower margins thickened into lateral ridges. Outer surface of the phragmocone chambers finely ridged with wrinkled radial and spiral lines giving a rasp-like appearance.

Remarks.—This species is distinct from all other American species of *Belosaepia* in several features, including the wrinkled surface of the ventral plate, the sharp bend in the rostrum, and the smoothly rounded profile below; other species are also more flattened ventrally. One unique specimen appears to show the remnants of four inner chambers, and thus shows the character of the rugose outer surface; its inner surface is apparently smooth. The shape of the cavity with the impressed lines, expanding strongly in the ventral direction, over the inner edge of the ventral plate and laterally, indicates that the phragmocone must have initially expanded in a ventral direction past the plate and a little in the direction of the beak, and then back towards the rostrum. One species from the Cuisian of the Paris Basin appears related, *Belosaepia tricarinata* (Watelet, 1851); this species also has a strongly bent beak and coarsely ribbed ventral plate; it can be distinguished by the strongly crescent-shaped ventral plate, larger size and stronger ornamentation on the dorsal side of the rostrum.

Etymology.—The specific name *penna* (Latin, wing), notes the thin, wide character of the ventral plate.

Type information.—Holotype: PRI 33130. Type locality: locality 20.

Material examined.—75 specimens, the largest: 10 mm from the center to the tip of the ventral plate, 13 mm height from the middle of the ventral plate to the base.

Subclass **NAUTILODEA** Agassiz, 1847, p. 246

Order **NAUTILIDAE** Agassiz, 1847, p. 246

Superfamily **NAUTILOIDEA** de Blainville, 1825

Family **HERCOGLOSSIDAE** Spath, 1927, p. 22

Genus **ANGULITHES** Montfort, 1808, p. 7

Type species.—*Nautilus triangulithes* Montfort, 1802, by original designation. Upper Cretaceous of France.

Diagnosis.—"Conch very involute, generally compressed, whorl sides slightly convex, strongly convergent, venter narrowly rounded to angular. Suture moderately sinuous with a narrowly rounded ventral saddle, a broad lateral lobe, a narrow, rounded saddle, and a small lobe on the umbilical shoulder. Siphuncle small and located near the dorsum." (Kummel, 1956, p. 454–455)

Remarks.—The genus has been reported from England, India, Senegal, Somalia, the only New World occurrence being from the Reklaw.

Angulithes elliotti (Stenzel, 1940)
Plate 23, figures 30–31

Deltoidnautilus elliotti Stenzel, 1940, p. 759–764, pl. 38, figs. 1–6, pl. 39, figs. 1, 2, text figs. 123(2), 124(2).
Angulithes elliotti (Stenzel, 1940). Kummel 1956, p. 35–456; Palmer and Brann, 1965, p. 372–373.

Description.—Shell involute, large and thick. Cross section of early whorls truncate-triangular, becoming gradually high-triangular with a sharply rounded venter. Ornamentation absent except for growth lines and very indistinct wavy raised spirals best developed near the umbilicus. Lateral zones very long and gently curved or flat, converging towards the venter at an angle of 48°. Septa closely spaced and convex; siphuncle slightly less than one-quarter of the distance from the dorsum, siphuncle collar tubular and long. Ventral saddle the largest, and prominently rounded-triangular, lateral lobe broad and gently curved; lateral saddle relatively deep and narrow lying a short distance from the umbilical shoulder, a medium sized lobe on the narrow perforate umbilicus; dorsum with a broad lobe.

Remarks.—One additional specimen found in a sandy lens in Ridge Creek.

Type information.—Holotype: TBEG 20901. Type locality: locality 6.

Family **ATURIIDAE** Hyatt, 1894[17]

Genus **ATURIA** Bronn, 1838, p. 1122

Type species.—*Nautilus aturi* Basterot, 1825, by subsequent designation (Hermannsen, 1846, p. 90). Miocene of southwestern France.

Diagnosis.—Shell involute, compressed, cross section initially triangular-oval, becoming subrectangular by the last whorl. Early whorls widest at or near the umbilical shoulder, becoming widest in the vicinity of the lateral zones. Umbilical shoulder not well defined, umbilical area one-ninth to one-eighth of whorl height. Lateral zones gently curved, in the last whorl nearly parallel medially, converging at an angle of 29° to 32° from the middle to the broadly evenly rounded venter. Septa convex, siphon narrow and funicular. Sutures slightly wavy across the venter, a small, narrow saddle at the corner of the base of the rapidly tapering and pinched lateral lobe; lateral saddle evenly rounded.

Remarks.—The genus is known from the Paleocene to the Miocene.

[17] Kummel *in* Moore (1964) cites Chapman (1857) as author of the family name Aturiidae. Extensive search has failed to locate this reference. Aturinae Hyatt, 1894, cited in Kummel (1956), is used *nomen transl.* Aturiidae herein.

Aturia turneri, Stenzel, 1940
Plate 23, figures 29–30

Aturia (Brazaturia) turneri Stenzel 1940, pp. 732, 766, 770, pl. 41, figs. 1–6, text-figs. 125 (2), 126 (7).
Aturia turneri Stenzel. Stenzel (1942), Cephalopoda cards Nos. 27a, 27b, figs. 1–5, text-figs. 125 (2), 126 (7); Miller, 1947, p. 108, pl. 72, figs. 1–5; Kummel, 1956, pp. 343, 468; Palmer and Brann, 1965, p. 375.

Description.—Shell involute, compressed, and flat lenticular in shape; cross section of body whorl subrectangular. Early whorls widest at or near the umbilical shoulder, but last preserved whorl widest in the region from the vicinity of the umbilical shoulder to the middle of the lateral zones. Umbilical shoulder and area as in the genus. Lateral zones are only gently curved in the earlier whorls and converge at an angle of about 29° ; lateral zones of the last preserved whorl gently curved and nearly parallel from the vicinity of the umbilical shoulder to their middle, but converging at an angle of 32° from their middle on towards the venter; venter broadly and evenly rounded. Sutures slightly wavy across venter; a small narrow saddle at the ventral corner of the base of the lateral lobe; lateral lobes rapidly tapering and pinched in at the point which is recurved dorsally; lateral saddle broadly arched.

Remarks.—Several small fragments and two larger ones discovered, most extremely pressure distorted. One partial clay mold shows the characteristic suture pattern well and another large portion of the body whorl has the lateral zones converging at an angle of about 30° and also shows a deep and well-rounded hyponomic sinus. Small nautiloid cephalopods are not at all rare in the unctuous dark clays in the Reklaw, particularly at Joe Taylor Branch, but they are almost always small, thin-shelled, very fragile, and tend to be destroyed at the moment of discovery. Another small species of nautiloid, which is very globose, and possibly a *Eutrephorceras* sp., is not uncommon at Joe Taylor Branch, but no specimen complete enough for description has been recovered.

Type information.—Holotype: TBEG 20905. Type locality: locality 6.

REFERENCES CITED

Abbott, R. T.
1974. American Seashells. 2nd. Edition. Van Nostrand Reinhold Company, New York, 663 pp., 24 pls.

Adams, A.
1849. *in* **Sowerby, G. B. II**, Thesaurus Conchyliorum or monographs of genera of shells. vol. 2, pt. 10, pp. 157–168, pls. 117–125, 31b, 118 bis.
1853. *in* **H. Adams, and A. Adams**, The genera of recent Mollusca arranged according to their organization. London. vol. 1: parts 1–8, pp. 1–256, pls. 1–32.
1860a. On some new genera and species of Mollusca from Japan. Annals and Magazine of Natural History, vol. 3, pt. 34, pp. 299–303, pt. 45, pp. 405–413.
1860b. Mollusca Japonica: New species of *Odostomia.* Annals and Magazine of Natural History, ser. 3, vol. 6, pp. 109–113.
1862. On Some New Species of Cylichnidae, Bullidae, and Philidinae, from the Seas of China and Japan. Annals and Magazine of Natural History, ser. 3, vol. 9, pp.150–161.
1863a. On the genera and species of Liotiinae found in Japan. Proceedings of the Zoological Society of London, vol. 30, pp. 71–76.
1863b. On the Japanese species of *Siphonalia,* a proposed new species of gasteropodus Mollusca. Annals and Magazine of Natural History, ser. 3, vol. 11, pp. 202–206.
1864. On some new Genera and Species of Mollusca from the Seas of China and Japan. Annals and Magazine of Natural History, ser. 3, vol. 13, pp. 307–310.

Adams, C. B.
1852. Catalog of shells collected at Panama, with notes on synonymy, station, and habitat &c. Annals of the Lyceum of Natural History of New York, vol. 5, pp. 229–549.

Adams, H., and Adams, A.
1853–1858. The genera of recent Mollusca arranged according to their organization. London. vol. 1: parts 1–8, pp. 1–256, pls. 1–32 (1853); vol. 1: parts 9–15, pp. 257–484, pls. 33–60. vol. 2: parts 16–18, pp. 1–72, pls. 61–72 (1854); vol. 2: parts 19–24, pp. 93–285, pls. 73–96 (1855) vol. 2: parts 25–28, pp. 286–412, pls. 97–112 (1856); vol. 2: parts 29–32, pp. 413–540, pls. 113–128; vol. 3: parts 33–35, pp. 541–661, pls. 129–138 (1858).

Afshar, F.
1969. Taxonomic revision of the Superspecific Groups in the Cretaceous and Cenozoic Tellinidae. Geological Society of America, memoir no. 119, pp. 1–215, pls. 1–45.

Agassiz, L.
1847. Nomenclatoris zoologici index universalis, continens nomina systematica classium, ordinum, familiarium et generum animalium omnium, tam viventium quam fossilium &c. Soloduri. pp. i–viii, 1–393.

Aldrich, T. H.
1885. Notes on the Tertiary of Alabama and Mississippi, with descriptions of new species. Cincinnati Society of Natural History, Journal vol. 8, no. 2, pp. 145–153, pls. 2, 3 5 in part.
1886. Preliminary report on the Tertiary fossils of Alabama and Mississippi. Part I. pp. 15–60, pls. 1–6, tables 1–10, in: Smith, E. A., Geological Survey of Alabama, Bulletin no. 1, 85 pp., 9 pls.
1887. Notes on Tertiary fossils, with description of new species. Cincinnati Society of Natural History, Journal, vol. 10, no. 2, pp. 78–83, 1 fig.
1890. A new Eocene fossil from Texas. Nautilus, vol. 4, no. 3, pp. 25.
1895. New or little known Tertiary Mollusca from Alabama and Texas. Bulletins of American Paleontology, vol. 1, no. 2, 30 pp., 5 pls.
1897. Notes on Eocene Mollusca with descriptions of some new

species. Bulletins of American Paleontology, vol. 2, no. 8, 26 pp., 5 pls.

1903a. New species of Eocene fossils from the Lignitic of Alabama. Nautilus, vol. 17, no. 2, pp. 19–20, 2 figs.

1903b. New species of Tertiary Molluscs from Alabama, Mississippi and Florida. Nautilus, vol. 16, no. 9, pp. 97–101, pls. 3–4.

1910. New Eocene fossils from the southern states. Nautilus, vol. 24, pp. 73–75, pl. 4.

1911. New Eocene fossils from the southern Gulf states. Bulletins of American Paleontology, vol. 5, no. 22, pp. 1–24, pls. 1–5.

1921. New Eocene species from Alabama. Bulletins of American Paleontology, vol. 9, no. 37, 32 pp., 3 pls.

Allen, J. E.

1968. New species of Sepiidae (Mollusca, Cephalopoda) from the Eocene of the Gulf coast. Tulane Studies in Geology, vol. 6, no. 1, pp. 33–38, 2 pls.

1970. New species of Eocene Mollusca from the Gulf Coast. Tulane Studies in Geology, vol. 8, no. 2, pp. 69–98, pls. 1–2.

Allmon, W.D.

1990. Review of the *Bullia* Group (Gastropoda: Nassariidae) with comments on its evolution, biogeography, and phylogeny. Bulletins of American Paleontology, vol. 99, no. 335, pp. 1–179, 15 pls.

Anton, H. E.

1839. Verzeichnis der Conchylien welche sich in der Sammlung von H. E. Anton befinden. Herausgegeben von dem Besitzer. Halle. pp. i–xvi, 1–110.

Ascanius, P.

1772. *Philine quadripartita,* Et forut obekant sjo-krok, aftecknadt och beskriftvet. Kungliga Svenska Vetenskapsakademiens Handlingar, vol. 33, pp. 329–331, pl. 10.

Baker, H. B.

1956. Familial names in land operculates. Nautilus, vol. 70, pp. 28–31.

Bannahan, A. R.

1950. Foraminifera and Peleoecology of a Portion of the Marquez Member, Reklaw Formation (Middle Eocene) in Bastrop County, Texas. Unpublished MA Thesis, University of Texas at Austin, pp. 1–59, 2 pls.

Barry, J. O. and LeBlank, R. E.

1942. Lower Eocene faunal units of Louisiana. Geological Survey of Louisiana, Bulletin, no. 23, 208 pp., 19 pls., 6 text figs., 2 tab.

Bartsch, P.

1911. The recent and fossil Mollusks of the Genus *Cerithiopsis* from the West Coast of America. Proceedings of the United States National Museum, vol. 40, no. 1823, pp. 327–367, pls. 36–41.

1917. A monograph of West American Melanellid Molluscs. Proceedings of the United States National Museum, vol. 53, no. 2207, pp. 295–356, pls. 34–49.

Basterot, B. de

1825. Déscription géologique du Bassin Tertiaire du sud-ouest de la France, première partie, comprenant les observations générales sur les Mollusques fossiles, et la description particulière de ceux qu'on rencontre dans ce bassin. Muséum National d'Histoire Naturelle, Mémoire, tome 2, pp. 1–100, pls. 1–7.

Bather, F. A.

1888. Shell-growth in Cephalopoda (Siphonopoda). Annals and Magazine of Natural History, no. 4, pp. 298–310.

Bayan, J. F. F.

1873. Etudes faites dans la Collection de l'École des Mines sur des Fossiles nouveaux ou mal connus. Fasc. 2, pp. 81–164. Paris.

Bayle, E.

1880. Liste rectification de quelques noms de genera et d'espèces. Journal de Conchyliologie, vol. 28, pp. 240.

Bellardi, L.

1872–1888. I Molluschi dei terreni terziarii del Piemonte e della Liguria. Memorie della (Reale) Accademia delle Scienze. Torino. Pt.. 1, Cephalopoda, Pteropoda, Heteropoda, Gasteropoda (Muricidae et Tritoniidae). Ser. 2, tom. 27, pp. 1–264, pls. 1–15 (1872); Pt.. 2, Gasteropoda (Pleurotomidae). Ser. 2, Tom. 29, pp. 1–364, pls. 1–9 (1877); Pt.. 3, Gasteropoda (Buccinidae, Cyclopsidae, Purpuridae, Coralliophilidae, Olividae). Ser. 2, tom. 34, pp. 1–253, pls. 1–12 (1882); Pt.. 4, Fasciolaridae e Turbinellidae. Ser. 2, tom. 37, pp. 1–62, pls. 2 (1884); Pt.. 5, Mitridae. Ser. 2, tom. 38, pp. 1–85, pls. 1–2, pp. 1–67, pls. 3–4 (1887); Pt. 5, Mitridae (fine). Sert. 2, tom. 39, pp.1–48, pls. 5–6 (1888).

1847. Monographie delle Pleurotome fossili de Piemonde. Memorie della (Reale) Accademia della Scienze di Torino, Memorie, ser. 2, tom. 9, pp. 531–650, 4 pls.

1875a. Novae Pleurotomidarum Pedemontii et Liguriae fossilium dispositionis prodromus. Bollettino Societa Malacologica Italiana, vol. 1, pp. 16–24.

1875b. Monographia della Nuculidi Trovate Finora nei Terreni Terziari del Piemonte e della Liguria. Annuario del Reale Liceo Gioberti di Torino, nell Anno scolastico 1874–1875, Torino. 32 pp., 1 pl.

Bernard, F. R.

1974. Septibranchs of the eastern Pacific (Bivalvia Anomalodesmata). Allen Hancock Foundation, Monographs in Marine Biology, no. 8, pp. 1–279, pls. 1–33.

Beurlen, K.

1944. Beiträge zur Stammesgeschichte der Muscheln. Bayerische Akademie der Wissenschaften, Sitzungsberichte, no. 1–2, pp. 133–145.

Bieler, R.

1984. Die Gattungen der Architectonicidae (Gastropoda: "Heterogastropoda") Allgemeines und Teil 1: *Pseudomalaxis.* Archiv für Molluskenkunde, vol. 115, pp. 53–103, pls. 1–5.

Blainville, H. M. D. de

1814. Mémoire sur les classifications méthodiques des animaux mollusques, et établissement d'une nouvelle consideration pour y parvenir. Extraits des Procées-Verbaux des Séances, Soçiété Philomathique de Paris, pp. 175–180.

1816–1830. Dictionnaire des Sciences Naturelles . . . Nouvelle édition, &c. 60 vols. and atlas of plates. vol. 32, pp. 1–567 (1824); vol. 56, pp. 1–546 (1828).

1825–1827. Manuel de Malacologie et Conchyliologie, &c. Paris and Strasbourg. vol. 1, pp. viii + 1–647 (1825); vol. 2, pp. 649–664, 87 pls. (1827).

Born, I. von.

1778. I. a Born . . . Index Rerum naturalium Musei Caesarei Vindobonensis Pars Inia Testacea.—Verzeichniss, &c. Vindobonae. pp. i–xlii, 1–478, 1 pl.

Bory de Saint Vincent, J. B. G. M

1832–1836. Expedition Scientifique de Morée. 3 vol and Atlas. Paris.

Bosc, L. A. G.

1816–1819. Nouveau Dictionnaire d'Histoire Naturelle. Deter-

ville, Paris. vol. 1: pp. 1–592; vol. 5: pp. 1–614; vol. 7: pp. 1–586: vol. 15: pp. 1–550.

Bouvier, E. L.
1887. Système nerveux, morphologie générale et classification des Gastéropodes prosobranches. Annales des Sciences Naturelles, vol. 7, pp. i–iii, 1–510, pls. 1–19.

Bowdich, T. E.
1822. Elements of Conchology, including the fossil genera and animals. Paris and London. Pt. 1: Univalves, 79 pp., 19 pls., pt. 2: Bivalves and Multivalves, 40 pp., 8 pls.

Bowles, E. O.
1939. Eocene and Paleocene Turritellidae of the Atlantic and Gulf Coastal Plain of North America. Journal of Paleontology, vol. 13, no. 3, pp. 267–336, pls. 31–34.

Boury, E. de
1887a. Étude sur les sous-genres de Scalidae du Bassin de Paris. Paris. Part I. 143 pp.
1887b. Description des Scalidae nouveaux des couches éocènes du Bassin de Paris et révision de quelques espèces mal connues. 86 pp. Paris.
1890. Étude critique des Scalidae miocènes et pliocènes d'Italie. Bollettino Societa Malacologica Italiana, vol. 15, pp. 81–213, pl. 4.
1909. Catalogue des sous-genres de Scalidae. Journal de Conchyliologie, vol. 57, pp. 255–258. Paris.
1910. étude sur les sous-genres de Scalidae, vivants et fossiles. Part II. Monographies des Gyroscala (I). Part II. Monographie des *Circuloscala.* Journal de Conchyliologie, vol. 62, pp. 212–260, 4 figs.
1913. Observations sur quelques éspèces ou sous-genres de Scalidae. Journal de Conchyliologie, vol. 61, pp. 65–112. Paris.

Brann, D. C., and Kent, L. S.
1960. Catalogue of the type and figured specimens in the Paleontological Research Institution. Bulletins of American Paleontology, vol. 40, no. 184, 996 pp., 1 pl.

Bratcher, T. and Cernohorsky, W. O.
1987. Living Terebras of the World. Melbourne. 240 pp., 68 pls.

Bretsky, S. S.
1976. Evolution and classification of the Lucinidae (Mollusca; Bivalvia). Palaeontographica Americana, vol. 8, no. 56, 337 pp., 16 pls.

Brocchi, G. B.
1814. Conchiologia Fossile Subapennina con Osservazioni Geologiche sugli Appennini e sul suolo adjacente con travole. Milan. vol. 1: General discussion, 240 pp.; vol. 2: Discussion of fossils, pp. 241–712, 16 pls.

Broderip, W. J. and Sowerby, G. B. II.
1829. Observations on new or interesting Mollusca contained for the most part in the Museum of the Zoological Society. Zoological Journal, vol. 4, pp. 359–379, 1 pl.

Bronn, H. E.
1831. Ergebnisse meiner naturhistorischöconomischen Reisen durch die Schweitz, Italien und Südfrankreich in den Jahren 1824–27. 2 vols., Heidelberg and Leipzig. 832 + 32 pp., 12 illust.
1835–1838 Lethaea geonostica oder Abbildung und Beschreibung der für die Gebirgsformationen bezeichnendsten Versteinerungen. Stuttgart. Bd. 1, pp. 1–768 (1835–1837); Bd. 2, pp. 769–1346, 48 pls. (1838).
1849. Handbuch der Geschichte der Natur. vol. 3, pt. 3: Index Palaeontologicus, Stuttgart. 976 pp.
1862. Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. Bd. 3, Abth. 1. Kopflose Weichthiere (Malacozoa Acephala). pp. 1–518, pls. 1–44; Abth. 2. Kopftragende Weichthiere (Malacozoa Cephalopora), pp. 521–1500, pls. 45–136.

Brown, A. P., and Pilsbry, H. A.
1911. Fauna of the Gatun Formation, Isthmus of Panama. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 63, pp. 336–373, pls. 22–29, 3 figs.

Brown, T.
1827. Illustrations of the conchology of Great Britain and Ireland. First edition. Edinburgh and London. pp. i–viii, 52 pls., with interleaved text of fly-leaves.

Bruguière, J. G.
1789–1816. Encyclopédie methodique ou par ordre de matières, Histoire naturelle des Vers, de Mollusques. Pls. 391–488 by Lamarck [ed.]. pp. 1–344 (1789); Atlas pls. 1–189 (1791); pp. 345–758 (1792); pp.190–286 (1797); pp. 287–390 (1798); pp. 391–488 (1816).

Bush, K.
1897. Revision of the marine gastropods referred to *Cyclostrema, Adeorbis, Vitrinella,* and related genera with descriptions of some new genera and species belonging to the Atlantic fauna of America. Transactions of the Connecticut Academy of Arts and Sciences, vol. 10, pp. 94–144.

Call, R. E.
1891. The Geology of Crowley's Ridge. Geological Survey Arkansas, Annual Report, vol. 2, 223 pp., 8 pls.

Carpenter, P. P.
1857. Catalogue of the Collection of Mazatlan Shells in the British Museum collected by Frederick Reigen. 552 pp. London.

Casey, T. L.
1903. Notes on the Conrad collection of Vicksburg fossils, with descriptions of new species. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 55, pp. 261–283.
1904. Notes on the Pleurotomidae with descriptions of some new genera and species. Transactions of the St. Louis Academy of Sciences, vol. 14, no. 5, pp. 123–170.

Cernohorsky, W. O.
1970. Systematics of the Families Mitridae and Volumitridae (Mollusca. Gastropoda). Bulletin of the Auckland Institute and Museum, no. 8., ix + 190 pp., 18 pls.
1972. Marine shells of the Pacific. vol. 2, 411 pp., 68 pls. Pacific Publications, Sydney.

Chavan, A.
1969. Systematic descriptions. *in* Treatise on Invertebrate Paleontology. R. C. Moore, *ed.*, pt. N, vol. 2 of 3, Mollusca 6, Bivalvia.

Chemnitz, J. H.
1784. *in* **Martini, F. H. W.**, Neues systematisches Conchylien-Cabinet [Bd. 1–3] geordnet und beschrieben von F. H. W. martini (fortgesetzt [Bd. 4–11] durch J. H. Chemnitz, [Bd. 12] G. H. Schubert . . . . A. Wagner, &c. 12 Bd.

Children, J. G.
1823. Lamarck's Genera of Shells, translated from the French. Quarterly Journal of Literature, Science and the Arts, vol. 16, pp. 49–79, pls. 5–6.

Chistikov, S. D.
1975. Some problems in scaphopod taxonomy. *in* Molluscs, their systematic, evolution and significance in nature. I.M. Likharev, *ed.*, pp. 18–21. Academy of Science, Leningrad (In Russian).

Clark, W. B. and Martin, G. C.
1901. The Eocene Deposits of Maryland. Geological Survey Maryland, pp. 1–331, pls. 1–54.

Clark, W.
1851. On the Classification of the British Marine Testaceous Mollusca. Annals and Magazine of Natural History, vol. 7, pp. 469–481.
Collins, E. W.
1980. The Reklaw formation of East Texas. *in* Perkins, B. F. and Hobday, D. K. *eds.*, Middle Eocene coastal plain and nearshore deposits of East Texas, a field guide to the Queen City Formation and related papers. SEPM, Gulf Coast, Guidebook, pp. 67–70.
Conrad, T. A.
1831. Descriptions of fifteen new species of recent and three of fossil shells, chiefly from the coast of the United States. Journal of the Academy of Natural Sciences of Philadelphia, vol. 6, pp. 256–268, pl. 11.
1832–1835. Fossil shells of the Tertiary formations of North America, illustrated by figures drawn on stone by T. A. Conrad. vol. 1, no. 1, pp. i–viii, 9–20 (1832a); vol. 1 no. 2, pp. 21–28, pls. 7–14 (1832b); vol. 1, no. 3, pp. 29–38 (1833a); vol. 1, no. 4, pp. 39–46 (1833b); vol. 1, Nos. 3–4, pp. 29–56, pls. 15–18 (1835).
1833c. On some new fossils and recent shells of the United States. American Journal of Science, 1st. ser., vol. 23, no. 2, art. 17, pp. 339–346.
1834. Appendix: Catalogue of the fossil shells of the Tertiary formation of the United States by Timothy A. Conrad. pp. 1–8. *in* **Morton, S. G.**, Synopsis of the organic remains of the Cretaceous group of the United States. pp. 1–84, 19 pls. Philadelphia.
1845. Descriptions of the eight new fossil shells of the United States. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 2, no. 6, pp. 173–175.
1847. Observations on the Eocene formation, and description of one hundred and five new fossils of that period from the vicinity of Vicksburg, Mississippi; with an appendix: (Descriptions of new Eocene fossils [from South Carolina] in the cabinet of Lardner Vanuxem). Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 3, pp. 280–296. Appendix, pp. 297–299.
1848. Observations on the Eocene formations, and descriptions of one hundred and five new fossils from that period, from the vicinity of Vicksburg, Mississippi; with an appendix. Journal of the Academy of Natural Sciences of Philadelphia, 2nd. ser., vol. 1, pp. 111–134, pls. 11–14.
1853a. Notes on shells. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 6, pp. 320–321.
1853b. Synopsis of the genera *Cassidula* Humph. and of a proposed new genus *Athleta*. Proceedings of the Academy of Natural Sciences of Philadelphia. 1853, vol. 6, pp. 448–449.
1854. *in* **Wailes, B. L. C.,** Report on the agriculture and Geology of Mississippi . . . Jackson, Mississippi, 371 pp., 17 pls. Fossils of the Vicksburg Eocene beds. Described by T. A. Conrad, pp. 287: Fossil Testacea of the Tertiary green-sand and marl-bed of Jackson, Miss. Determined and named by T. A. Conrad, 289 pp., pls. 14–17.
1855. Descriptions of fossil shells from the Eocene and Miocene formations of California. Report of explorations and surveys to ascertain a route for a railroad from the Mississippi River to the Pacific Ocean. Pacific Railroad Report, vol. 5, pp. 320–329, pls. 2–9.
1856. Observations of the Eocene deposits of Jackson, Mississippi, with descriptions of thirty-four new species of shells and corals. Proceedings of the Academy of Natural Sciences of Philadelphia, 1855, vol. 7, pp. 257–263.
1860. Descriptions of some new species of Cretaceous and Eocene fossils of Mississippi and Alabama. Journal of the Academy of Natural Sciences of Philadelphia, 2nd. ser., vol. 4, pt. 3, pp. 275–289, pls. 46–47.
1865a. Catalogue of the Eocene and Oligocene Testacea of the United States. American Journal of Conchology, vol. 1, no. 1, pp. 1–35, corrections pp. 190+(2).
1865b. Descriptions of new Eocene shells from Enterprise Mississippi. American Journal of Conchology, vol. 1, no. 2, pp. 137–141, pls. 10–11.
1865c. Descriptions of new Eocene shells, and references with figures to published species. American Journal of Conchology, vol. 1, no. 3, pp. 210–212, pls. 20–21 in part.
1865d. Descriptions of five new species of older Eocene shells from Shark River, Monmouth Co., N.J. American Journal of Conchology, vol. 1, no. 3, pp. 213–215, pls. 20–21 in part.
1866a. Check list of invertebrate fossils of North America. Eocene and Oligocene. Smithsonian Miscellaneous Collections, vol. 7, no. 200, pp. 1–41.
1866b. Further observations of Mr. Gabb's Paleontology of California. American Journal of Conchology, vol. 2, no. 2, pp. 97–100.
1867. Descriptions of new Miocene shells. American Journal of Conchology, vol. 3, no. 2, pp. 186–187.
1872. Descriptions and illustrations of genera of shells. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 24, pp. 50–55, pls. 1–2.
Cooper, J. G.
1894. Catalogue of Californian fossils. Parts 2–5. California State Mining Bureau, Bulletin, vol. 4, 65 pp., 6 pls.
1896. On some new Cretaceous and (Eocene?) Mollusca of California. Proceedings of the California Academy of (Natural) Sciences, ser. 2, vol. 6, no. 24, pp. 330–337, pls. 47–48.
Cossmann, A. E. M.
1887–1913. Catalogue illustré des coquilles fossiles de l'éocène des Environs de Paris. Annales de la Société Royale Malacologique de Belgique. Pelecypodes. Tom. 22, ser. 4, tom. 3, pp. 3–214, pls. 1–8 (1887); Scaphopodes et Gasteropodes. Tom. 23, ser. 4, tom. 3, pp. 3–324, pls. 1–12 (1888); Scaphopodes et Gasteropodes. Tom. 24, ser. 4, tom. 4, pp. 3–381, pls. 1–12 (1889); Appendix no. 1, tom. 28, pp. 1–18, text figs (1893a); Appendix no. 2, tom. 31, pp. 3–94, pls. 1–3 (1896a); Appendix no. 3, tom. 36, pp. 9–110, pls. 2–7 (1901a–1902); Appendix no. 4, tom. 41, pp. 186–286, pls. 6–10 (1906a); Appendix no. 5, tom. 49, pp. 19–238, pls. 1–8 (1913).
1893b. Notes complémentaires sur la faune éocénique de l'Alabama. Annales de Géologie et de Paléontologie. Palermo, Turin. Livr. 12, 51 pp., 2 pls.
1895–1925. Essais de Paléoconchologie comparée. Paris, private, 13 livraisons. Livr. 1, 159 pp., 7 pls. (1895); Livr. 2, 179 pp., 8 pls. (1896b); Livr. 3, 201 pp. 8 pls. (1899); Livr. 4, 293 pp., 10 pls. (1901b); Livr. 5, 215 pp., 9 pls. (1903); Livr. 6, 151 pp., 9 pls. (1904); Livr. 7, 261 pp., 14 pls. (1906b); Livr. 8, 248 pp., 4 pls. (1909); Livr. 9, 215 pp., 10 pls. (1912); Livr. 10, 292 pp., 12 pls. (1916); Livr. 11, 388 pp., 11 pls. (1918); Livr. 12, 549 pp., 6 pls. (1921); Livr. 13, 345 pp., 11 pls. (1925).
Cossmann, A. E. M., and Lambert, J.
1884. Étude Paléontologique et Stratigraphique sur le Terrain oligocène marin aux environs d'Estampes. Mémoires de

la Société Géologique de France, Ser. 3, vol. 3, no. 1, pp. 1–187, pls. 1–6.

Cossmann, A. E. M. and Martin, K.

1914. *in* **Martin, K.,** Die Fauna des Oberoligocans von Nanggulan auf Java. Sammlung des Geologischen Reichsmueums in Leiden.

Peyrot, A.

1932. *in* **Cossmann, M., and Peyrot, A.** 1909–1935. Conchologie néogénique de l'Aquitaine. Actes de la Société Linnéenne de Bordeaux, vol. 84, fasc. 1, pp. 5–128, pls. 7–10.

Cossmann, A. E. M., and Pissarro, G.

1910–1913. Iconographie complète des Coquilles Fossiles de l'Éocene des Environs de Paris. Tome 2, pp. 1–20, pls. 1–55.

Costa, E. M. da

1776. Elements of Conchology or, an introduction to the knowledge of shells. London. 318 pp., 7 pls.

1778. Historia naturalis testaceorum Britanniae or the British Conchology containing the descriptions and other particulars of the Natural History of shells of Great Britain and Ireland. 254 pp., 17 pls., index.

Cotton, B. C.

1959. South Australian Mollusca. Archeogastropoda. Handbook of the Flora and Fauna of South Australia, W. L. Hawkes, Adelaide. pp. 1–449, 215 figs.

Cotton, B. C. and Woods, N. H.

1935. The correlation of recent and fossil Turritellidae of Southern Australia. Records of the South Australian Museum, vol. 5, pp. 369–387, 9 figs.

Couthouy, J. P.

1839. Monograph on the family Osteodesmacea. Boston Journal of Natural History, vol. 2, no. 2, pp. 129–189, 1 pl.

Cox, L. R.

1930. The fossil fauna of the Samana Range and some neighbouring areas. Pt. 8: The Mollusca of the Haingu Shales. Memoirs Geological Survey India, Paleontographica Indica, n.s., vol. 15, pp. 129–222, pls. 17–22.

1931. *Sycostoma*, a renamed genus of lower Tertiary gastropoda. Proceedings of the Malacological Society of London, vol. 19, pp. 291.

1960. Systematic descriptions. *in* Treatise on Invertebrate Paleontology. R. C. Moore *ed.*, pt. I, Mollusca 1, Mollusca-General Features Scaphopoda Amphineura Monoplacophora Gastropoda-General Features Archeogastropoda and some (mainly Paleozoic) Caenogastropoda and Opisthobranchia.

Cox, L. R., and Knight, J. B.

1960. Systematic descriptions. *in* Treatise on Invertebrate Paleontology. R. C. Moore *ed.*, pt. I, Mollusca 1, Mollusca-General Features Scaphopoda Amphineura Monoplacophora Gastropoda-General Features Archeogastropoda and some (mainly Paleozoic) Caenogastropoda and Opisthobranchia..

Cristofori, J., and Jan, G.

1832. Catalogus in IV sectiones divisus rerum naturalium in museo extantium Josephi de Cristofori et Georgii Jan. Milano. Sect. 2, part 1, 16 pp.

Curry, D.

1965. The English Paleogene pteropods. Proceedings of the Malacological Society of London, vol. 36, pp. 357–371, 1 pl.

1981. Pteropods Éocènes de la Tuilerie de Gan (Pyrénees-Atlantiques) et de quelques autres Localités du SW de la France. Cahiers de Micropaléontologie, vol. 4, pp. 35–44, 1 pl.

Cuvier, G.

1797. Tableau élémentaire de l'histoire naturelle des Animaux. Paris. pp. i–xvi, 1–710, 14 pls.

Dall, W. H.

1881. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78) and the Caribbean Sea (1879–80) by the U.S. Survey Steamer "Blake", Lieut. Commander C.P. Sigsbee, U.S.N. and Commander J. R. Bartlett U.S.N., commanding. Preliminary report on the Mollusca. Bulletin of the Museum of Comparative Zoology, Harvard College, vol. 9, no. 2, pp. 33–144.

1886. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78) and the Caribbean Sea (1879–80) by the U.S. Survey Steamer "Blake", Lieut. Commander C.P. Sigsbee, U.S.N. and Commander J. R. Bartlett U.S.N., commanding. XXIX. Report on the Mollusca. Part 1, Brachiopoda and Pelecypoda. Bulletin of the Museum of Comparative Zoology, Harvard College, vol. 12, no. 6, pp. 171–318, pls. 1–9.

1889a. On the hinge of Pelecypods and its development with an attempt towards a better subdivision of the group. American Journal of Science, vol. 38, no. 3, pp. 445–462.

1889b. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78) and the Caribbean Sea (1879–80) by the U.S. Survey Steamer "Blake", Lieut. Commander C.P. Sigsbee, U.S.N. and Commander J. R. Bartlett U.S.N., commanding. XXIX. Report on the Mollusca.. Part II: Gastropoda and Scaphopoda. Bulletin of the Museum of Comparative Zoology, Harvard College, vol. 18, pp. 1–492, 13 pls.

1889c. A preliminary catalogue of the shell-bearing marine mollusks and brachiopods of the southeastern coast of the United States, with illustrations of many of the species. Bulletin of the United States National Museum, no. 37, pp. 1–232, pls. 1–95.

1890–1903. Contributions to the Tertiary fauna of Florida, with especial reference to the Miocene Silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River. Trans. Transactions of the Wagner Free Institute of Science of Philadelphia, vol. 3. Part 1: Pulmonata, opistobranchiate and orthodont gastropods. pp. 1–200, pls. 1–12 (1890); Part 2: Streptodont and other gastropods. pp. 201–473, pls. 13–22 (1892); Part 3: A new classification of the pelecypoda. pp. 475–570 (1895); Part 4: I. Prionodesmacea: Nucula to Julia. II. Teleodesmacea: Teredo to Ervillia. pp. 571–948, pls. 23–36 (1898); Part 5: Teleodesmacea concluded. pp. 949–1217, pls. 37–47 (1900); Part 6: Concluding part. pp. 1219–1645, pls. 48–60 (1903).

1896a. Diagnosis of new Tertiary fossils from the southern United States. Proceedings of the United States National Museum, vol. 18, no. 1035, pp. 21–46.

1896b. Descriptions of Tertiary Fossils from the Antillean Region. Proceedings of the United States National Museum, vol. 19, no. 1110, pp. 303–331, pls. 27–30.

1899. Synopsis of the Recent and Tertiary Leptonacea of North America and the West Indies. Proceedings of the United States National Museum, vol. 21, no. 1177, pp. 871–897, pls. 87–88.

1907. *in* **Dall, W. H., and Bartsch, P.,** The Pyramidellid Mol-

lusks of the Oregonian Faunal Area. United States National Museum Proceedings, vol. 33, no. 1574.
1909a. Report on a collection of shells from Peru, with a summary of the littoral marine Mollusca of the Peruvian zoological province. Proceedings of the United States National Museum, vol. 37, no. 1704, pp. 147–294, pls. 20–28.
1909b. Contributions to the Tertiary paleontology of the Pacific coast. I. The Miocene of Astoria and Coos Bay, Oregon. United States Geological Survey Professional Paper 59, 148 pp., 23 pls. Appendices 1–13, pp. 149–216, index pp. 263–278.
1915. A monograph of the molluscan fauna of the *Orthaulax pugnax* zone of the Oligocene of Tampa, Florida. Bulletin of the United States National Museum, no. 90, 173 pp., 26 pls.
1919. Descriptions of new species of mollusks of the family Turritidae from the west coast of America and adjacent regions. Proceedings of the United States National Museum, vol. 56, no. 2288, pp. 1–86, pls. 1–24.
1924. Notes on molluscan nomenclature. Proceedings of the Biological Society of Washington, vol. 37, pp. 87–90.

Dall, W. H., and Bartsch, P.
1903. Pyramidellidae and stratigraphy of the marine Pliocene and Pleistocene of San Pedro, California. Memoirs of the California Academy of Sciences, vol. 3, pp. 269–285, pls. 1–2, pl. 4, fig. 14.
1904. Synopsis of the genera, subgenera and sections of the family Pyramidellidae. Proceedings of the Biological Society of Washington, vol. 17, pp. 1–16.
1907. The Pyramidellid Mollusks of the Oregonian Faunal Area. United States National Museum Proceedings, vol. 33, no. 1574, pp. 491–534, pls. 44–48.
1909. A Monograph of the West American Pyramidellid Mollusks. Bulletin of the United States National Museum 68, pp.1–258, pls. 1–30.

Dana, J. D.
1895. Manual of Geology. Boston. 4th. ed., 1087 pp., illust., maps, text figs.

Darte, N. H., Stephenson, L. W., Gardner, J. A.
1932. Geologic map of Texas. (preliminary edition). U.S. Geological Survey, Washington, DC.

Davis, K. E.
1961. The foraminiferal and lithologic characteristics of the Reklaw formation of Leon, Robertson and Milam Counties, Texas. Unpublished Master's thesis, Texas A & M University, College Station, Texas, 97 pp., 23 figs.

Deshayes, G. -P.
1824a–1832a. Descriptions des Coquilles fossiles des environs de Paris. Tome I. Conchifères. pp. 1–80 (1824a); pp. 81–170 (1825a); pp. 171–238 (1829); pp. 239–322 (1830); pp. 323–392 (1832a);
1833a. Mollusques par M. Deshayes. *in* **Bory de Saint Vincent, J. B. G. M,** Expedition Scientifique de Morée. vol. 3, pt. 1 and Atlas, sect. 1, pp. 209.
1824b–1835. Descriptions des Coquilles fossiles des environs de Paris. Tome II. Gastropodes. pp. 1–80 (1824b); pp. 81–146 (1825b); pp. 147–290 (1832b); pp. 291–426 (1833b); pp. 427–498 (1834a); pp. 499–780 (1835a).
1856–1866. Descriptions des Animaux sans vertèbres découverts dans le bassin de Paris pour servir de supplément a la description des coquilles Fossiles des environs de Paris, comprenent une revue génèrale de toutes les espèces actuellement connues. Paris, 3 vol. text, 2 vol. atlas. vol. 1. Text: pp. 1–80; atlas: pls. 1–10 (1856); vol. 1. Text: pp. 81–392; atlas: pls. 11–49 (1857); vol. 1. Text: pp. 393–704; atlas: pls. 50–87 (1858); vol. 1. Text: pp. 705–912 (1860); vol. 2. Text: pp. 1–432; atlas: pls. 1–26 (1861); vol. 2. Text: pp. 433–640; atlas: pls. 27–39 (1862); vol. 2. Text: pp. 641–920; atlas: pls. 40–62 (1863); vol. 2. Text: pp. 921–968 (1864); vol. 3. Text: pp. 1–658; atlas vol. 2: pls. 63–107 (1865); vol. 3. Text: Index (1866).

Deussen, A.
1924. Geology of the Coastal Plain of Texas west of the Brazos River. United States Geological Survey, Professional Paper 126-D, 145 pp., 35 pls.

Dickerson, R.E.
1913. Fauna of the Eocene at Marysville Buttes, California. University of California Publications in Geological Sciences, Bulletin, vol. 7, no. 12, pp. 257–298, pls. 11–14.

Dillwyn, L. W.
1817. A descriptive catalog of Recent shells, arranged according to the Linnean method; with particular attention to the synonymy. vol. 1, pp. i–xii, 1–580; vol. 2, pp. 581–1092.

Dockery, D. T. III.
1977. Mollusca of the Moodys Branch Formation, Mississippi. Mississippi Geological Survey, Bulletin 120, 212 pp., 27 pls.
1980. The invertebrate macropaleontology of Clarke County, Mississippi. Mississippi Geological Survey, Bulletin 122, 387 pp., 82 pls., 36 figs.
1984. *in* **MacNeil, F. S. and Dockery, D. T. III.,** Lower Oligocene Gastropoda, Scaphopoda, and Cephalopoda of the Vicksburg Group of Mississippi. Mississippi Geological Survey, Bulletin 124, pp. 1–415, 72 pls.
1993. The Streptoneuran gastropods, exclusive of the Stenoglossa, of the Coffee Sand (Campanian) of northeastern Mississippi. Mississippi Geological Survey, Bulletin 129, pp. 1–190, 42 pls.

Dumble, E. T.
1890. First Annual Report of the Geological Survey of Texas, 1889. pp. 1–410, figs. map. Austin.
1892. Report on the Brown Coal and Lignite of Texas. Geological Survey of Texas. pp. 1–243, figs., map. Austin.

Duméril, A. M. C.
1806. Zoologie analytique, ou méthode naturelle de classification des Animaux. Paris, pp. 1–344.

Dunker, W.
1853. Neue Mytilacean. Zeitschrift für Malakozoölogie, vol. 10, pp. 82–92.

Dunlap, J. B. jr.
1955. The Geology of the area bordering the Brazos river in southeastern Milam and northeastern Burleson Counties, Texas. Unpublished Master's thesis, Texas A&M University, College Station, Texas, 91 pp., 32 figs.

Eames, F. E.
1952. A contribution to the study of the Eocene in Western Pakistan and Western India. C: The description of the Scaphopoda and Gastropoda from standard sections in the Rakhi Nala and Zinda Pir areas of the Western Punjab and in the Kohat District. Philosophical Transactions of the Royal Society of London, Ser. B. Biological Sciences, no. 631, vol. 236, pp. 1–168, pls. 1–6.

Elisor, A. C.
1929. Correlation of the Claiborne of east Texas with the Claiborne of Louisiana. Bulletin of the American Association of Petroleum Geologists, no. 13, pp. 1335–1346, 2 figs., 1 pl.

Edwards, F. E.
1856. A Monograph of the Eocene Mollusca, or descriptions of

shells from the older Tertiaries of England. Part iii. Prosobranchia. Monograph of the Palaeontographical Society, vol. 1, pp. 181–240, pls. 24–26.

1866. *in* **Lowry, J. W., Etheridge, R. E., and Edwards, F. E.** Chart of the characteristic British Tertiary fossils, stratigraphically arranged.

Edwards, H. M.

1845–1849. Recherches anatomiques et zoologiques faites pendant un voyage sur les côtes de la Scilie et sur divers du littoral de la France, par Mm. H. M. Edwards . . . A. de Quatrefages . . . et E. Blanchard, &c. 3 pts. Tome 9: Note sur la classification naturelle des Mollusques Gastéropodes. Annales des Sciences Naturelles, Paris. Zoologie. Ser. 3, vol. 9, pp. 102–112. (1848).

Emerson, W. K.

1962. A classification of the Scaphopod molluscs. Journal of Paleontology, vol. 36, no. 3, pp. 461–482, pls. 76–80, figs, 1–2.

English, W. A.

1914. The Fernando Group near Newhall, California. University of California Publications in Geological Sciences, vol. 8, no. 8, pp. 203–218, pl. 23.

Erickson, R. J.

1982. The gastropod fauna of the Wheelock Member, Cook Mountain formation (Middle Eocene) of East Texas. Unpublished Master's thesis. Louisiana State University, Baton Rouge, Louisiana, 274 pp., 11 pls.

Férussac, A. E. J. P. J. F. d'A. de

1822. Tableaux systematiques des animaux mollusques. pp. i–xlviii, 1–114 pp. Paris and London.

Férussac, A. E. J. P. J. F. d'A. de, and d'Orbigny, A. D.

1839. Histoire naturelle générale et particulière des Céphalopodes Acétabulifères vivants et fossils . . . Ouvrage commencé par MM. de Férussac et A. d'Orbigny et continué par A. d'Orbigny. pp. i–lvi, 1–361; Atlas: 96 pp, 144 pls. Paris

Férrusac, J. B. L. d'A. de

1819–1832. Histoire naturelle générale et particulère des Mollusques terrestres et fluuviatiles . . . Oeuvre posthume de M. le Baron J. B. L. d'Audebard de Férussac . . .. continué mis en ordre, et publié. vol. 1, Nos. 1–28, 128 pp., 162 pls..

Finlay, H. J., and Marwick, J.

1937. The Wangoloan and associated molluscan faunas of Kaitangata Green Island subdivision. New Zealand Geological Survey, Paleontological Bulletin 15, pp. 1–140, pls. 1–17.

Fischer, P. H.

1880–1887. Manuel de Conchyliologie et des Paléontologie Conchyiologique ou Histoire Naturelle des Mollusques vivantes et Fossiles. Paris. Part 1, pp. 1–112 (1880); parts 2–3, pp. 113–304 (1881); part 4, pp. 305–416, pls. 1–3 (1882); parts 5–6, pp. 417–608, pl. 13 (1883); part 7, pp. 609–688, pls. 4–7, 12 (1884); parts 8–9, pp. 689–896, pls. 8–11, 14 (1885); part 10, pp. 897–1008, pl. 16 (1886); part 11, pp. 1009–1369, pl. 15, 17–12 (1887).

Fisher, W. L.

1961. Stratigraphic names in the Midway and Wicox Groups of the Gulf Coastal Plain. University of Texas Publications, Report of Investigations, no. 44, pp. 263–295.

Fisher, W. L. Rodda, P. U., and Dietrich, J. W.

1964. The evolution of *Athleta petrosa* stock (Eocene, Gastropoda) of Texas. University of Texas Publications, no. 6413, 117 pp., 11 pls.

Fleming, J.

1817. New Edinburgh Encyclopaedia [D. Brewster, Ed.]. (1813–1831) Vols. 1–18 text, vols. 19–20 pls. Philadelphia. Conchology. in vol. 7, pt. 12, pp. 55–107, pls. 203–206

1822. The Philosophy of Zoology; or a general view of the structure, functions, and classifications of Animals. Paris and London. vol. 1, pp. 1–432, 5 pls.; vol. 2, pp. 1–618.

1828. A history of British animals, exhibiting the descriptive characters and systematical arrangement of the genera and species of quadrupeds, birds, reptiles, fishes and Radiata of the United Kingdom. Edinburgh. pp. 1–54.

Forbes, E.

1838. Malacologie Monensis. A catalogue of the Mollusca inhabiting the Isle of Man and the neighboring sea. Edinburgh. 63 pp., 3 pl.

Forbes, I., and Hanley, S. C.

1848–1853. A history of British Mollusca and their shells. London. vol. 1, pp. i–lxxx, 1–477, pls. A-O, 1–34 (1848); vol. 2, pp. i–viii, 1–557, pls. P-U, AA-NN, 35–74, 77–79 (1850); vol. 3, pp.i–x, 1–616, pls. EE-ZZ, 75–76, 80–94D (1851); vol. 4, pp. i–vi, 1–301, pls. W, MM, AAA-SSS, 94–133 (1853).

Forney, P.L., and Nitecki, M.

1976. The Type Fossil Molluscs (Hydrolitha, Polyplacophora, Scaphopoda, Monoplacophora and Gastropoda) in the Field Museum. Fieldiana Geology, vol. 36, pp. 1–240.

Furon, R., and Soyer, R.

1947. Catalogue des Fossiles Tertiaires du Bassin de Paris. Guides Techniques du Naturaliste. Paris. vol. 6, pp. 1–240, pls. 1–32.

Gabb, W. M.

1860. Descriptions of new species of American Tertiary and Cretaceous fossils. Journal of the Academy of Natural Sciences of Philadelphia, 2nd. ser., vol. 4, pt. 4, pp. 375–406, pls. 67–69.

1864. Description of the Cretaceous fossils. California Geological Survey, Paleontology, vol. 1, sect. 4, pp. 57–243, pls. 9–32.

1869. Cretaceous and Tertiary fossils. California Geological Survey, Paleontology, vol. 2, 299 pp., 36 pls.

Gardner, J.

1923. New species of Mollusca from the Eocene deposits of southwestern Texas. United States Geological Survey Professional Paper 131-D, pp. 109–115, pls. 29–33.

1924. *in* **Deussen, A,** Geology of the Coastal Plain of Texas west of the Brazos River. United States Geological Survey Professional Paper 126.

1926. The nomenclature of the supraspecific groups of Corbula in the lower Miocene of Florida. Nautilus, vol. 40, no. 2, pp. 41–47.

1927. New species of Molluscs from the Eocene of Texas. Journal of the Washington Academy of Sciences, vol. 17, no. 14, pp. 362–383, figs. 1–44.

1932. *in* **Darte, N. H., Stephenson, L. W., and Gardner, J. A.,** Geologic map of Texas (preliminary edition). U.S. Geological Survey, Washington, DC.

1933. The Midway group of Texas, including a chapter on the coral fauna by Thomas Wayland Vaughan and Willis Parkinson Popenoe. University of Texas Bulletin, 3301, 403 pp., 28 pls., 4 text figs.

1939. Notes on fossils from the Eocene of the Gulf Province. United States Geological Survey Professional Paper 193-B, pp. 17–44, pls. 1–8.

1943. Mollusca from the Miocene and lower Pliocene of Virginia and North Carolina Part I. Pelecypoda. United States

Geological Survey Professional Paper 199-A, pp. 1–178, pls. 1–23.
1945. Mollusca from the Tertiary formations of northeastern Mexico. Geological Society of America Memoir 11, 332 pp., 28 pls., map, 6 tab., 1 fig.
1947. The Molluscan fauna of the Alum Bluff Group of Florida, pt. 8, United States Geological Survey Professional Paper 142-H, pp. 493–656, pls. 52–62.
1951. Two new guide fossils from the Tallahatta formation of the southeastern United States. Journal of the Washington Academy of Sciences, vol. 41, no. 1, pp. 8–12.
1957. Little Stave Creek—A Paleoecologic Study. *in* Ladd, H. S., *ed.*, Treatise of Marine Ecology and Paleoecology. vol. 2: Paleoecology. Geological Society of America Memoir 67, pp. 573–588.

Gardner, J., and Bowles, E. O.
1939. The *Venericardia planicosta* group in the Gulf Province. United States Geological Survey Professional Paper 189-F, pp. 141–215, pls. 33–46.

Gill, T.
1867. On the genus *Fulgar* and its allies. American Journal of Conchology, vol. 3, pp. 141–152, 1 fig.

Givens, C. R. and Garvie, C. L.
1994. *Strepsidura ficus* (Gabb) of Harris (1895), Eocene, Texas: Not Conspecific with *Whitneya ficus* Gabb (1864), Eocene, California (Gastropoda, Volutidae). Journal of Paleontology, vol. 68, no. 2, pp. 274–278, 10 figs.

Glibert, M.
1938. Faune Malacologique des Sables de Wemmel. II. Gastropodes, Scaphopodes, Céphalopodes. Institute Royale des Sciences Naturelles de Belgique, Mémoire, no. 85, 190 pp., 4 pls.
1962a. Les Archeogastropoda Fossiles du Cénozoïque étranger des Collections de L'Institute Royale des Sciences Naturelles de Belgique. Institute Royale des Sciences Naturelles de Belgique, Mémoire, 10th. ser., fasc. 68, 131 pp.
1962b. Les Mesogastropoda Fossiles du Cénozoïque étranger des Collections de L'Institute Royale des Sciences Naturelles de Belgique. Institute Royale des Sciences Naturelles de Belgique, Mémoire, 10th. ser., fasc. 69, 305 pp.

Glibert, M, and Poel, L. van de
1965. Les Bivalvia Fossiles du Cénozoïque étranger des Collections de L'Institute Royale des Sciences Naturelles de Belgique. II. Pteroconchida, Colloconchida et Isofilbranchia. Institute Royale des Sciences Naturelles de Belgique, Mémoire, 2nd. ser., fasc. 78, 105 pp.

Gmelin, J. F.
1791. Systema Naturae per Regia Tria Naturae. 13th. ed. Leipzig. pt. 1, pp. 1517–2224.

Golikov, A., and Starobogatov, Y. I.
1975. Systematics of Prosobranch Gastropods. Pt. 7. Malacologia, vol. 15, pp. 185–232.

Gould, A. A.
1841. Report on the invertebrata of Massachusetts comprising the Mollusca, Crustacea, Annelida, and Radiata. Pt. 7: Invertebrata. Zoological and Botanical Survey of Massachusetts, pp. i–ix, 1–370, 14 pls.

Grabau, A. W.
1904. Phylogeny of Fusus and its allies. Smithsonian Miscellaneous Collections, vol. 44, no. 1417, 192 pp., 18 pls.

Granata, G.
1877. *in* **Raymondo-Granata, G.**, Sul Cirropterum semilunare Sars e del nuvo sottogenero Monophorus. vol. 3, 7 pp., 1 pl.

Grant, U. S., and Gale, H. R.
1931. Catalogue of the marine Pliocene and Pleistocene Mollusca of California and adjacent regions. Memoirs San Diego Society of Natural History, vol. 1, 1036 pp., 32 pls.

Grateloup, J. P. S. de
1840–1847. Conchyliologie Fossile des terraines Tertiaires du bassin de l'Adour (Environs de Dax), Bordeaux. Tome 1: Univalves, Atlas, xx + 12 pp., 48 pls.

Gray, J. E.
1824. Shells. *in* **Sabine, E., Kirby, W., Gray, J. E., Konig, C., and Brown, R.,** A supplement to the appendix of Captain Parry's voyage for the discovery of a North-West Passage in the years 1819–20. Containing an account of the subjects of natural history. pp. 181–310, 5 pls. *in* **Parry, W. E.**, Journal of a voyage for the discovery of a North-West Passage from the Atlantic to the Pacific . . . 1819–20 &c.
1834. Alphabetical list of the figures of Mollusca in "Griffiths" Cuvier, pp. 595–601, *in* **Griffith, E., and Pidgeon, E.**, Mollusca and Radiata, *in* **Griffith, E.**, The Animal Kingdom arranged by the Baron Cuvier with supplementary additions to each order. London. pp. 601, 43 pls.
1840. Synopsis of the contents of the British Museum. 42nd. ed., British Museum (London). 370 pp.
1842. Synopsis of the contents of the British Museum. 44th. ed., British Museum (London). 308 pp.
1847a. A list of the genera of Recent Mollusca, their synonyms and types. Proceedings of the Zoological Society of London, pt. 15, pp. 129–219.
1847b. On the classification of British Mollusca, by Dr. W. Leach. Annals and Magazine of Natural History, vol. 20, pp. 267–273.
1850. *in* **Gray, M. E.**, 1850. Figures of Molluscous Animals selected from various authors. vol. 4: Explanation of plates and list of genera.
1853a. (Leach MS) Molluscorum Britanniae synopsis. A synopsis of the Mollusca of Great Britain, arranged according to their natural affinities and anatomical structure. [Edited from the author's proofs and MS by J. E. Gray.] London. Text xli, 376 pp., 13 pls.
1853b. On the division of ctendobrancheous gasteropodous Mollusca into larger groups and families. Annals and Magazine of Natural History, ser. 2, vol. 11, pp. 124–133.
1857. The guide to the systematical distribution of Mollusca in the British Museum. Pt. II. Annals and Magazine of Natural History, ser. 2, vol 19.

Gray, M. E.
1850. Figures of Molluscous Animals selected from various authors. vol. 4: Explanation of plates and list of Genera. London. pp. 1–219.

Gregorio, A. de
1880. Fauna di San Giovanni Illarione (Parisiano) Monographia. Parte Ia: Cefalopoda e Gastropodi. Palermo. Fasc. 1, pp. i–xxvii, 1–106, 8 pls.
1884. Intorno ad alcure nuove cochliglie mioeniche da Sicilia. Naturalista Siciliano, Giornale di Scienze Naturali, vol. 3, no. 4, pp. 119–120.
1890. Monographie de la Faune éocénique de l'Alabama et surtout de celle de Claiborne de l'étage Parisien (Horizon à *Venericardia planicosta* Lamk.). Annales de Géologique et de Paléontologie. Palermo. Livr. 7, 8, 316 pp., 46 pls.

Griffith, E.
1834. *in* **Griffith, E., and Pidgeon, E.** The Animal Kingdom arranged by the Baron Cuvier with supplementary additions to each order. London. 601 pp., 43 pls.

Guevara, E. H., and Garcia, R.
1972. Depositional Systems and Oil-Gas reservoirs in the Queen City Formation (Eocene), Texas. Bureau of Economic Geology, Geological Circular 72–4, pp. 1–22.

Guilding, L.
1834. Observations on *Naticinae* and *Dentalium,* two genera of Molluscous animals. Transactions of the Linnaean Society of London (for 1831), vol. 17, pp. 29–36.

Haller, B.
1988. Die Morphologie der Prosobranchia. Morphologischer Jahrbücher, vol. 14, pp. 54–169.

Hanna, M. A.
1927. Expedition of the California Academy of Sciences to the Gulf of California. Geology and Paleontology. (1921) Proceedings of the California Academy of (Natural) Sciences, vol. 16, ser. 4, no. 6, pp. 137–157, pl. 3.

Harasewych M. G., and Jensen, R. H.
1979. Review of the subgenus *Pterynotus* (Gastropoda: Muricidae) in the western Atlantic. Nemouria, no. 22, pp. 1–16, 19 text figs.

Hardenbol, J.
1994. Sequence stratigraphic calibration of Paleocene and Lower Eocene continental margin deposits in NW Europe and the US Gulf Coast with the ocean chronostratigraphic record. GFF (Geologiska Foereningen Foerhandlinger, Stockholm), vol. 116, pt. 1, pp. 49–51.

Harris, G. D.
1890. The genus *Terebellum* in the American Tertiaries. American Geologist, vol. 5, pp. 319.
1894. The Tertiary Geology of Southern Arkansas. Arkansas Geological Survey, Annual Report for 1892, vol. 2, 207 pp., 7 pls.
1895. New and otherwise interesting Tertiary Mollusca from Texas. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 47, pp. 45–88, pls. 1–9.
1895a. *in* **Dana, J. D.**, Manual of Geology. 4th. ed., Boston. 1087 pp.,
1895b. Claiborne fossils. Bulletins of American Paleontology, vol. 1, no. 1, 52 pp., pl. 1.
1896. The Midway stage. Bulletins of American Paleontology, vol. 1, no. 4, 156 pp., 15 pls.
1897a. New and otherwise interesting Eocene Mollusca from the Gulf States. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 48, pp. 470–482, pls. 18–23.
1897b. The Lignitic stage. Part I: Stratigraphy and Pelecypoda. Bulletins of American Paleontology, vol. 2, no. 9, 102 pp., 14 pls.
1899. The Lignitic stage. Part II: Scaphopoda, Gastropoda, Pteropoda and Cephalopoda. Bulletins of American Paleontology, vol. 3, no. 11, 128 pp., 12 pls.
1919. Pelecypoda of the St. Maurice and Claiborne stages. Bulletins of American Paleontology, vol. 6, no. 31, 268 pp., 59 pls.
1920. The genera Lutetia and Alveinus. Palaeontographica Americana, vol. 1, no. 2, pp. 3–14, pl. 17, text figs. 1–8.
1937. Turrid illustrations. Palaeontographica Americana, vol. 2, no. 7, 122 pp., 14 pls.
1946. *in* **Harris, G. D., and Palmer, K. V. W.**, 1946–1947. The Mollusca of the Jackson Eocene of the Mississippi Embayment (Sabine river to the Alabama river). Bulletins of American Paleontology, vol. 30, no. 117.

Harris, G. D. and Palmer, K. V. W.
1946–1947. The Mollusca of the Jackson Eocene of the Mississippi Embayment (Sabine river to the Alabama river). Bulletins of American Paleontology, vol. 30, no. 117, 564 pp., 65 pls Part I. Bivalves and bibliography for parts I and II. G. D. Harris, 206 pp., 25 pls. (1946); Part II. Univalves and index. K. V. W. Palmer, pp. 207–563, pls. 26–56, 62–64; pls. 57–61 by G. D. Harris (1947).

Harris, G. F.
1897. Catalogue of Tertiary Molluscs in the department of Geology. British Museum (Natural History). I. Australasian Tertiary Mollusca. London. pp. i–xxvi, 1–404, pls. 1–8.

Harris, G. F., and Burrows, H. W.
1891. The Eocene and Oligocene beds of the Paris Basin. London. pp i–viii, 1–129.

Harry, H. W.
1967. A Review of the Living Tectibranch Snails of the Genus *Volvulella,* with Descriptions of a New Subgenus and Species from Texas. Veliger, vol. 10, no. 2, pp. 133–147, 19 figs.

Haszprunar, G.
1988. On the origin and evolution of major gastropod groups, with special reference to the Streptoneura. Journal of Molluscan Studies, vol. 54, pp. 367–441.

Heaslip, W. G.
1968. Cenozoic evolution of the Alticostate Venericards in the Gulf and East Coastal North America. Palaeontographica Americana, vol. 6, no. 39, pp. 1–135 29 pls.

Hedley, C.
1902. Scientific results of the trawling expedition of H.M.C.S. "Thetis", Mollusca. Memoir 4, pt. 5, pp. 285–324.
1907. The Results of Deep-Sea Investigations in the Tasman Sea. 3: Mollusca from Eighty Fathoms off Narrabeen, Sydney, N.S.W. Records of the Australian Museum, vol. 6, no. 4, pp. 283–304, pls.54–56.
1922. A revision of the Australian Turridae. Records of the Australian Museum, vol. 13, pp. 213–359, pls. xlii–lvi.

Heilprin, A.
1879. On some new Eocene fossils from the Claiborne marine formation of Alabama. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 31, pp. 211–216, pl. 13.
1881. On some new lower Eocene Mollusca from Clarke Co., Ala., with some points as to their stratigraphic positions of the beds containing them. Proceedings of the Academy of Natural Sciences of Philadelphia. 1880, vol. 32, pp. 364–375, pl. 20.
1891. The Eocene Mollusca of the state of Texas. Proceedings of the Academy of Natural Sciences of Philadelphia. 1890, vol. 42, pp. 393–406.

Henderson, J. B.
1920. A monograph of the East American Scaphopod mollusks. Bulletin of the United States National Museum, no. 111, 177 pp., 20 pls.

Hermanns, J.
1781. Erster Brief über einige Conchylien. Der Naturforscher. Halle. vol. 16, pp. 50–56, Tab. 2.

Hermannsen, A. N.
1846–1852. Indicus generum malacozoorum primordia. vol. 1, text: 637 pp. (1846–1847); vol. 2, text: 717 pp. (1847–1849); supplement, 140 pp. (1852).

Hickman, C. S.
1976. Bathyl Gastropods of the family Turridae in the early Oligocene Keasey Formation in Oregon, with a review of some deep-water genera in the Paleocene of the Eastern Pacific. Bulletins of American Paleontology, vol. 70, no. 292, pp. 1–119, 7 pls.

Hinds, R. B.
1843. Description of new species of *Neaera,* from the collection of Sir Edward Belcher, C. B. Proceedings of the Zoological Society of London, pt. 11, pp. 75–79.
1845. The Zoology of the voyage of H.M.S. Sulphur under the command of Captain Sir Edward Belcher, R.N., C.B., F.R.G.S. etc. during the years 1836–42. vol. 2: Mollusca. London. pp. i–iv, 1–72, 21 pls.

Hodgkinson, K. A.
1974. Stone City and Cook Mountain (Middle Eocene) Scaphopods from Southwest Texas. University of Kansas Paleontological Contributions, pap. 70, 25 pp., 8 pls.

Hodgkinson, K. A., Garvie, C. L., and Bé, A. W. H.
1992. Eocene Euthecostomatous Pteropoda (Gastropoda) of the Gulf and Eastern Coasts of North America. Bulletins of American Paleontology, vol. 103, no. 341, pp.1–62, pls. 1–13.

Hodson, F.
1927. *in* **Hodson, F., and Hodson, H. K.** Some Venezuelan and Caribbean Mollusks. Bulletins of American Paleontology, vol. 13, no. 49, pp. 1–150, pls. 1–40.

Houbrick, R .S.
1977. Reevaluation and New Description of the Genus *Bittium* (Cerithiidae).The Veliger, vol. 20, no. 2, pp. 101–106, 1 pl.
1980. Review of the Deep-Sea Genus *Argyropeza* (Gastropoda: Prosobranchia: Cerithidae). Smithsonian Contributions to Zoology, no. 321, pp. 1–30, 12 figs.

Hulings, N. C.
1955. An investigation of the benthic invertebrate fauna from the shallow waters of the Texas coast. Unpublished M.A. Thesis, Texas Christian University, Fort Worth. 87 pp., 12 pls.

Hussey, K. M.
1949. Louisiana Cane River Eocene Foraminifera. Journal of Paleontology, vol. 23, no. 2, pp. 109–144.
1951. Two lower Claiborne index fossils. Cushman Foundation for Foraminiferal Research Contribution, vol. 2, pt. 1, pp. 19–20.

Hyatt, A.
1894. Phylogeny of an acquired characteristic. Proceedings of the American Philosophical Society, vol. 32, pp. 349–647, pls. 1–14.

Imbrie, J. and Newell, N. D. [eds.]
1964. Approaches to Paleoecology. Wiley, New York. 432 pp.

Iredale, T.
1915. A commentary on Suter's "Manual of New Zealand Mollusca". Transactions and Proceedings of the New Zealand Institute, vol. 47, pp. 417–497.
1916. On two editions of Dumeril's Zoologie Analytique. Proceedings of the Malacological Society of London, vol. 12, pp. 79–84.
1924. Results from Roy Bell's molluscan collections. Proceedings of the Linnean Society of New South Wales, vol. 49, pp. 179–278, pls. 33–36.
1929. Mollusca from the continental shelf of Eastern Australia. Records of the Australian Museum, vol. 17, pp.157–189, pls. 38–41.
1930. More notes on the marine Mollusca of New South Wales. Records of the Australian Museum, vol. 17, pp. 384–407, pls. 62–65.

Jeffreys, J. G.
1870. Mediterranean Molluscs. Annals and Magazine of Natural History, ser. 4, vol. 6, pp. 65–86, 457–458
1881. On the mollusca procured during the Lightning and Porcupine expeditions, 1868–70. Proceedings of the Zoological Society of London, part 3, pp. 693–724.
1884. On the mollusca procured during the Lightning and Porcupine expeditions, 1868–70. Proceedings of the Zoological Society of London. pp. 111–149, 341–372.

Jeletzki, J. A.
1966. Comparative morphology, phylogeny and classification of fossil Coleodea. University of Kansas Paleontological Contributions, Mollusca, art. 7, pp.1–162, 24 pls., 15 figs.

Johnson, C. W.
1899. New and interesting species in the "Isaac Lea Collection of Eocene Mollusca". Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 51, pp. 71–82, pls. 1–2.

Jousseaume, F. P.
1887. La famille des Cancellariidae. Le Naturaliste, ann. 9, 2nd. ser., pp. 155–157, 163, 192–194, 213–214, 221–223.

Jukes-Brown, A. J.
1908. On the genera of Veneridae represented in the Cretaceous and older Tertiary deposits. Proceedings of the Malacological Society of London, vol. 8, no. 3, pp. 148–177, 2 text figs., pl. 6.

Kabat, A. R.
1991. The classification of the Naticidae (Mollusca: Gastropoda): review and analysis of the supraspecific taxa. Bulletin of the Museum of Comparative Zoology, vol. 152, no. 7, pp. 417–449.

Keen, A. M.
1969. Systematic descriptions. *in* Treatise on Invertebrate Paleontology. R. C. Moore, *ed.*, pt. N, vol. 2 of 3, Mollusca 6, Bivalvia. pp. N491–N952.
1971. Sea Shells of Tropical West America. 2nd. ed., Stanford University Press, Stanford, California. 1064 pp.

Keen, A. M. and Bentson, H.
1944. Check list of California Tertiary marine Mollusca. Geological Society of America, Special Paper no. 56, 280 pp.

Kerferstein, W.
1862–1866. *in* **Bronn, H. G.**, Klassen und Ordnungen das-Thierreichs. Band 3: Malacozoa. pp. 1–1500, figs.

Kiener, L. -C.
1834. Species générale et iconographie des Coquilles vivantes. Mémoires du Muséum d'Histoire Naturelle. Paris, livr. 1–5, nouv. tome 3, 512 pp.

Knight, J. E., Hodgkinson, K. A., Knight S. A., Reid, T. G., Lindveit, G., Lindveit, F., and Offeman, I. D.
1977. Fossils & Locations of the Claiborne Group (Eocene) of Texas. A Symposium Conducted at Brazosport Museum of Natural Science. Texas Paleontology Series, pub. no. 1. Houston Gem and Mineral Society, 57 pp., 6 pls.

Knudsen, J.
1967. The deep-sea Bivalvia. Scientific Reports of the John Murray Expedition, vol. 11, pp. 237–343.

Kobelt, W.
1876–1881. Illustriertes Conchylienbuch. vol. 1, pt. 1, pp. 1–48, pls. 1–10 (1876); vol. 1, pt. 2, pp. 49–64 (1877); vol. 1, pt. 3, pp. 65–88; pt. 4, pp. 89–104, pt. 5, pp. 105–144 (1878); vol. 2, pts. 6–8, pp. 145–254 (1879); vol. 2, pt. 9, pp. 265–312 (1880); vol. 2, pts. 10–11, pp. 313–391, pls. 91–112 (1881).
1891. *in* **Martini F. H. W.**, Systematisches Conchylien-Cabinet von Martini und Chemnitz. Neu herausgegeben und vervollständigt von H. C. Kuster (nach dessen Tod fortgesetzt

von . . . W. Kobelt und H. C. Weinkauff). 11 Bd. and Index. Bd. 8, pt. 2: Die Gattung Arca L., pp. 1–30, pls. 1–49.

Koenen, A. von

1865. Die Fauna der unteroligocäne Tertiärschichten von Helmstädt bei Braunschweig. Zeitschrift der Deutschen Geologischen Gesellschaft, vol. 17, pp. 459–534, 702–706.

Korobkov, I. A.

1954. Spravochnik i metodicheskoe Rudovodstvo po tretichnym mollyuskam plastinchatozhabernye. [In Russian. Handbook on and systematic guide to the Tertiary Molluscs.] Gosud. Nachno-tech. Isedov. Nefi. Gorno-toplivnoi lit-ry, Leningradskoi Otdelenie, 444 pp., 96 pls.

Kuckenthal, W. and Krumbach, T.

1925. Handbuch der Zoologie, eine Naturgeschichte der Stämme des Tierreiches. Fünfter Band. Soenogastres. Mollusca. Echinodermata. pp. 1–275, 349 figs. Berlin and Leipzig.

Kummel, B.

1956. Post-Triassic nautiloid Genera. Bulletin of the Museum of Comparative Zoology, Harvard College, vol. 114, no. 7, pp. 324–494, 28 pls., 35 figs.

Kosuge, S.

1966. On the family Triphoridae of the late Mr. Hosoya's shell collection deposited in the Yokohama City Museum. Science Reports of the Yokohama Museum, no. 9, pp. 144–152.

Ladd, H. S. [ed.]

1957. Treatise of Marine Ecology and Paleoecology. vol. 2: Paleoecology. Geological Society of America Memoir 67, pp. 1–1077.

Lamarck, J. B. P. A. de M. de

1799. Prodrome d'une nouvelle classification des coquilles. Mémoires de la Société d'Histoire Naturelle de Paris, vol. 1, pp. 63–91.

1801. Systême des Animaux sans vertèbres ou tableau general des classes, des ordres et des genres de ces Animaux. Paris, 432 pp.

1802–1809. Mémoire sur les Fossiles des environs de Paris, comprenant la détermination des espèces qui apartiennent aux Animaux marines sans vertèbres, et dont la plupart sont figurés dans le collection des vélins du Museum. Annales du Muséum National d'Histoire Naturelles. Paris. vol. 1, pp. 299–312, 383–391, 474–478 (1802); vol. 2, pp. 57–64, 163–169, 217–227, 315–321, 385–391 (1803); vol. 3, pp. 163–170, 266–274, 343–352, 436–441. vol. 4, pp. 46–55, 105–115, 212–222, 289–298, 429–436. vol. 5, pp. 28–36, 91–98, 179–188, 237–245, 349–357 (1804); vol. 6, pp. 117–126, 214–228, pls. 1–4, pp. 337–345, 407–415 (1805); vol. 7, pp. 53–62, 130–139, 231–244, 419–430, pls. 5–7; vol. 8, pp. 77–79, 156–166, 347–355, 383–388, 461–469, pls. 8–14 (1806); vol. 9, pp. 236–240, 399–401, pls. 15–20 (1807); vol. 12, pp. 456–459, pls. 21–24 (1808); vol. 14, pp. 374–375, pls. 25–28 (1809).

1811. Sur la détermination des espèces parmi les Animaux sans vertèbres, et particulièrement parmi les Mollusques testacés. Annales du Muséum National d'Histoire Naturelles. Paris. vol. 17, pp. 54–80.

1812. Extrait du Cours de Zoologie du Muséum d'Histoire Naturelle sur les Animaux invertébrés, présentant la distribution et la classification de ces Animaux, les caractères des principales divisions, et une simple liste des genres, à l'usage de ceux qui suivent ce cours. 128 pp. Paris.

1815–1822. Histoire naturelle des Animaux sans vertèbres presentant les charactères généraux et particuliers de ces Animaux, leur distribution, leurs classes, leurs famillies, leurs genres, et la citation des principales espèces qui s'y rapportent, &c. 7 vols. Paris. vol. 5, 612 pp. (1818); vol. 6, 323 pp. (1819); vol. 7, 711 pp. (1822).

1816. *in* **Bruguière, J. G.**, Encyclopédie Méthodique ou par ordre de Matières . . . . Histoire Naturelle des Vers.

Langdon, D. W. Jr.

1886. Observations on the Tertiary of Mississippi and Alabama with descriptions of new species. American Journal of Science, vol. 131, 3rd. ser., vol. 31, no. 181, art. 20, pp. 202–209.

Latrielle, P. A.

1825. Familes naturelles du Règne Animale, exposées succintement et dans un ordre analytique avec l'indication de leur genres. Paris. 570 pp.

Lea, H. C.

1849. Catalogue of the Tertiary Testacea of the United States. Proceedings of the Academy of Natural Sciences of Philadelphia. vol. 4, pp. 95–107.

Lea, I.

1833. Contributions to geology. Philadelphia, 227 pp., 6 pls.

Leach, W. E.

1819. The classification of the British Mollusca. Journal de Physique, de Chimie et d'Histoire Naturelle, vol. 88.

LeBlanc, R. J.

1942. *in* **Barry, J. O., and LeBlanc, R. J.**, Lower Eocene faunal units of Louisiana. Geological Survey of Louisiana, Bulletin, no. 23, 208 pp., 19 pls., 6 text figs., 2 tab.

Link, H. F.

1806–1808. Beschreibung der Naturlichen-Sammlung der Universität zu Rostock. Abt. 2–3.VII. Mollusken. pp. 82–160 (1806); Abt. 4. Fossile überbleibsel organischer Korper, sogenannte Versteinerungen. pp. 6–23 (1807); Abt. 6. Nachträge und Verbesserungen. pp. 33–37 (1808).

Linnaeus, C.

1758. Systema naturae per regna tria naturae. 10th. ed. vol. 1; Regnum animale. Stockholm, pp. 1–824.

1767. Systema naturae per regna tria naturae. 12th. ed., vol. 1, pts. 1–2, Regnum Animale. Stockholm, pp. 1–1327.

Lovén, S. L.

1847. Index Molluscorum litora Scandivavia occidentalia habitatium. Malacozoologica öfersigt af Kongelige Vetenskaps-Akademiens Förhandlingar, pp. 175–199, pls. 2–6.

Lowry, J. W., Etheridge, R. E. and Edwards, F. E.

1866. Chart of the characteristic British Tertiary fossils, stratigraphically arranged. London. 4 pls., 800 figs.

Lyth, A. L. Jr.

1949. Reklaw formation in western Bastrop County, Texas. Unpublished Master's thesis. University of Texas at Austin, 96 pp., 4 pls.

Marincovich, L. N. Jr.

1977. Cenozoic Naticidae (Mollusca, Gastropoda) of the Northeastern Pacific. Bulletins of American Paleontology, vol. 70, no. 294, pp. 169–494, pls. 17–42.

Martin, K.

1914. Die Fauna des Oberoligocäns von Nanggulan auf Java. Sammlung des Geologischen Reichsmuseums in Leiden, vol. 2, pt. 4, pp. 107–178, 8 pls.

Martini, F. H. W.

1769–1829. Neues systematisches Conchylien-Cabinet [Bd. 1–3] geordnet und beschrieben von F. H. W. martini (fortgesetzt [Bd. 4–11] durch J. H. Chemnitz, [Bd. 12] G. H. Schubert . . . . A. Wagner, &c. 12 Bd. Bd. 8. pp. 12 + 1–

356, pls. 1–68 (1784); Bd. 12. pp. 1-xii, 1–196, pls. 1–237 (1829).

1837–1906. Systematisches Conchylien-Cabinet von Martini und Chemnitz. Neu herausgegeben und vervollständigt von H. C. Kuster (nach dessen Tod fortgesetzt von . . . W. Kobelt und H. C. Weinkauff). 11 Bd. and Index. Bd. 5, pt. 3: Die Gattung *Cypraea* und *Ovula*. pp. 1–29, pls. 1–53 (1881); Bd. 8, pt. 2: Die Gattung *Arca* L., pp. 1–30, pls. 1–49 (1891).

Marwick, J.

1924. The Tertiary and Recent Naticidae and Naricidae of New Zealand. Transactions and Proceedings of the New Zealand Institute, vol. 55, pp. 545–579, pls. 55–64.

MacNeil, F. S.

1937. The systematic position of the pelecypod genus *Trinacria*. Journal of the Washington Academy of Sciences, vol. 27, pt. 11, pp. 452–458, text fig.

MacNeil, F. S. and Dockery, D. T. III

1984. Lower Oligocene Gastropoda, Scaphopoda, and Cephalopoda of the Vicksburg Group in Mississippi. Mississippi Geological Survey, Bulletin 124, pp. 1–415, 72 pls.

McLean, J. H.

1971. A Revised Classification of the Family Turridae, with a Proposal of New Subfamilies, Genera, and Subgenera. Veliger, vol. 14, no. 1, pp. 114–130, 4 pls.

McPherson, J. H., and Gabriel, C. J.

1962. Marine Molluscs of Victoria. Melbourne. pp. 1–475, 486 figs.

Meek, F. B.

1864. Check lists of the Invertebrate fossils of North America. Miocene. Smithsonian Miscellaneous Collections, no. 183, pp. 1–32.

Melville J. C., and Standen, R.

1901. The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the Collections of Mr. F. W. Townsend, 1893–1900; with Descriptions of New Species. Proceedings of the Zoological Society of London, vol. 2, pp. 327–400, pls. 21–24.

1903. Descriptions of sixty-eight new Gastropoda from the Persian Gulf, Gulf of Oman, and North Arabian Sea, dredged by Mr. F. W. Townsend, of the Indo-European Telegraph Service. Annals and Magazine of Natural History, ser. 7, vol. 12, pp. 289–324, pls. 20–23.

Menard, G. de la

1807. Mémoire sur un nouveau genre de la famille des solenoides. Annales du Muséum d'Histoire Naturelle, Paris, vol. 9, pp. 135–136, pl. 12.

Meyer, O.

1885. The genealogy and the age of the species of the southern Old-Tertiary. Part I. American Journal of Science, vol. 129, 3rd. ser., vol. 29, no. 174, pp. 457–468.

1886. Part II. Contributions to the Eocene paleontology of Alabama and Mississippi. Geological Survey of Alabama Bulletin no. 1, pp. 61–85, pl. 1–3.

1887a. Beitrag zur Kenntnis der Fauna des Altteriärs von Mississippi und Alabama. Senkenbergische Natürforscher Gesellschaft in Frankfurt am Main, 22 pp., 2 pls.

1887b. On invertebrates from the Eocene of Mississippi and Alabama. Proceedings of the Academy of Natural Sciences of Philadelphia. vol. 39, pp. 51–56, pl. 3.

Meyer, O., and Aldrich, T. H.

1886. The Tertiary fauna of Newton and Wautubbee, Mississippi. Journal of the Cinncinnati Society of Natural History, vol. 9, no. 2, pp. 40–50, 64, pl. 2.

Mestayer, M. K.

1930. Notes on New Zealand Mollusca no. 5. Transactions and Proceedings of the New Zealand Institute, vol. 61, pp. 144–146, pl. 26.

Michelotti, G.

1847. Descriptions des Fossiles des Terrains Miocènes de l'Italie septentrionale, &c. Naturrkundige Verhandelingen van de Bataafsche Hollandsche Maaschappye der Wetenschappen te Haarlem, verz. 2, deel. 3, no. 2, 408 pp., 17 pls.

Miller, A. K.

1947. Tertiary Nautiloids of the Americas. Geological Society of America Memoir 26, 234 pp., 100 pls., 30 figs.

Miller, C.

1879. Die Binnenmollusken von Equador. (Schluss). Malakozoölogische Blaetter, neue ser., vol. 1, pp. 111–203, pls. 4–15.

Moll, F.

1941. Übersicht über die Teredinen des Museums für Naturkunde zu Berlin. Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, pp. 152–225.

Montague, G.

1803–1808. Testacea Britannica: an account of all the shells hitherto discovered in Britain. London. pp. i–xl, 1–606, pls. 1–16 (1803); Suppl., pp. i–v, 1–183, pls. 17–30 (1808).

Montfort, D. de

1802. Histoire naturelle, générale et particulière des Mollusques, Animaux sans vertèbres et sang blank; &c. Paris. vol. 4, pp. 1–376, pls. 42–50.

1808–1810. Conchyliogie systematique et classification méthodiques des coquilles. Paris. vol. 1: Coquilles univalves, cloisonnées, pp. 1–409, pls. 1–100 (1808); vol. 2: Coquilles univalves, non cloisonnees, pp. 1–676, figs. 1–161 (1810).

Monterosato, J. I. di

1875. Note intorno d alcuni articole di conchiologia mediterranae pubdlicati nel Jahrbücher der deutschen malakozoologischen Gesellschaft dal Signor H. C. Weinkauff e dal Dott. Kobelt. Bollettino Società Malacologica Italiana, vol. 1, pp. 68–73.

1880. Conchiglie della zona abissi. Bollettino Società Malacologica Italiana, vol. 6, pp. 50–82.

1883. Conchigle Littorali Mediterranee. Naturalistica Siciliano, no. 3, pp. 87–100.

1884. Nomenclature generica e specifica di alcure conchiglie mediterranee. Palermo. 152 pp.

1913. Note on the genus *Pseudomalaxis*, Fisher, and descripions of a new species and sub-genus. Proceedings of the Malacological Society of London, vol. 10, no. 6, pp. 362–363, fig.

Moore, E. J.

1962. Conrad's Cenozoic fossil marine mollusk type specimens at the Academy of Natural Sciences of Philadelphia. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 114, no. 2, pp. 23–120.

1983. Tertiary Marine Pelecypods of California and Baja California: Nuculidae through Malleidae. United States Geological Survey Professional Paper 1228-A, 108 pp., 27 pls.

Moore, R. C., editor.

1960. Treatise on Invertebrate Paleontology. Part I, Mollusca 1, Mollusca-General Features Scaphopoda Amphineura Monoplacophora Gastropoda-General Features Archeogastropoda and some (mainly Paleozoic) Caenogastropo-

da and Opisthobranchia. Geological Society of America, pp. i–xxiii + I1-I351, 261 figs.
1964. Treatise on Invertebrate Paleontology. Part K, Mollusca 3, Cephalopoda-General Features Endoceratoidea-Actinoceratoidea-Nautiloidea Bactritoidea. Geological Society of America, pp. i–xxviii + K1-K519, 361 figs.
1969. Treatise on Invertebrate Paleontology. Part. N, Mollusca 6, Bivalvia, vols. 1–2 of 3. Geological Society of America, pp. N1-N952, 621 figs.
1971. Treatise on Invertebrate paleontology. Part N, vol. 3 of 3, Mollusca 6, Bivalvia. Geological Society of America, pp. N953-N1124, 153 figs.

Mörch, O. A. L.
1852. Catalogue conchyliorum quae reliquit D'Alphonso d'Aguirra et Gadea Comes de Yoldi regis Daniae eubiculariorum princeps, ordis dannebrogici in prima classe & ordinis caroli tertii eques. Pt. 1: 170 pp., pt. 2: 74 pp. Hafniae.
1857. Fortegnelse over Gronlands Bløddyr. Tilloeg nr. 4. *in* **Rink, H. J.,** Groenland geographisk og statistik beskrevet. 2 vol., Copenhagen, pp. 75–100
1858. Note sur le genre *Volutharpa,* Fisher. Journal de Conchyliologie, vol. 7, pp. 40–44.
1875. Synopsis molluscorum marinorum Indiarum occidentalum imprimis insularum danicarum. Malakozoölogische Blätter, vol. 22, pp. 142–184.

Morton, S. G.
1834. Synopsis of the organic remains of the Cretaceous group of the United States. Philadelphia. pp. 1–84, 19 pls.

Naef, A.
1921. Das System der dibranchiaten Cephalopoden und die mediterranean Arten derselben. Mitteilungen aus der Zoologische Station zu Neapel, Berlin. vol. 22, pp. 527–542.

Natland, M. L.
1957. Paleoecology of West Coast Tertiary Sediments. *in* Ladd, H. S., *ed.*, Treatise of Marine Ecology and Paleoecology. vol. 2: Paleoecology. Geological Society of America Memoir 67, pp. 543–572.

Nelms, K. C.
1979. Sedimentology and Faunal Analysis of a marginal marine section, the Stone City member (Middle Eocene), Crockett formation, Burleson County, Texas. Unpublished Master's thesis. Texas &M University, College Station, Texas. 189 pp.

Neumayr, M.
1883. Zur Morphology des Bivalvenschlosses. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematische-Naturwissenschaftlichen Klasse, Abh. 1, vol. 88, no. 1, pp. 385–418, 2 pls.

Newell, N. D.
1965. Classification of the Bivalvia. American Museum Novitates, no. 2206, pp. 1–25, 3 figs.

Newton, R. B.
1891. Systematic list of the Frederick E. Edwards collection of British Oligocene and Eocene Mollusca in the British Museum (Natural History). British Museum (Natural History), pp. 1–365.
1922. Eocene Mollusca from Nigeria. Nigeria Geological Survey, Bulletin 3, pp. 1–114, pls. 1–11.

Nuttall, C. P. and Cooper, J.
1973. A revision of some English Paleogene Nassariidae, formerly referred to *Cominella.* Bulletin of the British Museum (Natural History). Geology. vol. 23, no. 3, 219 pp., 1 fig., 9 pls.

Nyst, P. H.
1843. Description des Coquilles et des Polypiers fossiles des terrains Tertiaires de la Belgique. Mémoires de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, vol. 17, 688 pp., pls. 1–15.

Odhner, N. H.
1939. Opistobranchate Mollusca from the western and northern coasts of Norway. Konigelige. Kongelige Norske Videnskabers Selskabs. Skrifter, vol. 1, pp. 1–93

Olsson, A. A.
1964. Neogene mollusks from northwestern Ecuador. Paleontological Research Institution, Ithaca, N.Y. 258 pp., 38 pls.

Oppenheim, P.
1896. Die Eozänfauna des Monte Postale in Veronesischen. Palaeontographica, vol. 47, pp. 1–348, 21 pls.

d'Orbigny, A. D.
1834–1844. Voyage dans l'Amérique Meridionale . . . exécuté pendant . . .1826–33 par A. D. d'Orbigny, &c. vol. 3, Paléontologie, xliii + 758 pp. (1842a); vol. 5, Mollusques . . . ., pp. 49–184, (1836); pp. 377–424, pls. 53, 67, 70–71 (1840a).
1839. *in* **Férussac, A. é J. P. J. F. d'A., and d'Orbigny, A. D.**, Histoire naturelle générale et particulière des Céphalopodes Acétabulifères vivants et fossiles . . . Ouvrage commencé par MM. de Férussac et A. d'Orbigny et continué par A. d'Orbigny. pp. i–lvi, 1–361; Atlas: 96 pp, 144 pls. Paris
1840b–1894. Paléontologie Française. Description zoologique et géologique de touts les Animaux Mollusques et Rayonnés fossiles de France. 24 vols., Paris. Tome 1, Terrains Crétacés. Céphalopodes, 662 pp., 148 pls (1840b–1841a); Tome 2, Terrains Crétaces. Gasteropodes, 456 pp., pls. 49–236 (1842b–1843).
1841b–1853. Mollusques. *in* **Sagra, R de la,** Histoire physique, politique et naturelle de l'Ile de Cuba. vol. 1, pp. 1–208 (1841c); vol. 1, pp. 209–264, vol. 2, pp. 1–112 (1842c); vol. 2, pp. 113–380 (1846).
1850. Prodrome de paléontologie stratigraphique universelle des animaux mollusques & rayonnés faisant suite au cours élémentaire de paléontologie et de géologie stratigraphiques. Paris, vol. 2, 427 pp.

Pace, S.
1902. Contributions to the study of the Columbellidae. Proceedings of the Malacological Society of London, vol. 5, pp. 36–154.

Palmer, D. B. K.
1923. A fauna from the middle Eocene shales near Vacaville, California. University of California Publications, Bulletin, Geological Sciences, vol. 14, no. 8, pp. 289–318, pls. 52–57.

Palmer, K. V. W.
1928. *in* **Price, W. A., and Palmer, K. V. W.,** A new fauna from the Cook Mountain Eocene near Smithville, Bastrop County, Texas. Journal of Paleontology.
1937. The Clairbornian Scaphopoda, Gastropoda and dibranchiate Cephalopoda of the southern United States. Bulletins of American Paleontology, vol. 7, no. 32, pt. 1, 548 pp., pt. 2, 90 pls.
1942. Substitutes for Molluscan homonyms. Journal of Paleontology, vol. 16, no. 5, pp. 674.
1947. *in* **Harris, G. D., and Palmer, K. V. W.**, The Mollusca of the Jackson Eocene of the Mississippi embayment (Sa-

bine river to the Alabama river). Bulletins of American Paleontology.

Palmer, K. V. W., and Brann, D. C.
1965–1966. Catalogue of the Paleocene and Eocene Mollusca of the southern and eastern United States. Bulletins of American Paleontology, vol. 48, no. 218. Part 1. Pelecypoda, Amphineura, Pteropoda, Scaphopoda and Cephalopoda, pp. 1–466, pls. 1–3 (1965); Part 2. Gastropoda, pp. 467–1057, pls. 4–5 (1966).

Parry, W. E.
1821–1824. Journal of a voyage for the discovery of a North-West Passage from the Atlantic to the Pacific . . . 1819–20 &c. London. 310 pp.

Pchelintsev, V. F., Korobkov, I. A., Volkova, N. S., Vostokova, V. A., Mironova, L. V., Ovechkin, N. K., and Sukhova, A. I.
1960. Mollyuski-Bryukhonogie, Osnovy Paleontologii. Gosudarstvenno nauchno-tekhnicheskoe izdatel'stvo literatury po geologii i okhrane nedr. [Fundamentals of Paleontology. Mollusca.] [In Russian] Mockba, vol. 4, pp. 1–360.

Pennant, T.
1777. British Zoology. 4th. ed., vol. 4, pp. i–xi, 1–154, 93 pls. Warrington.

Penrose, R. A. F. Jr.
1889. in: **Dumble, E. T.**, First Annual Report of the Geological Survey of Texas. Austin. pp. 1 –410.

Perrilliat, M. del C.
1984. Monographia de los Moluscos del Mioceno medio de Santa Rosa, Veracruz; Parte VII Pelecipodos: Dreissenidae a Verticordiidae. Paleontologia Mexicana, no. 48, pp. 1–88, pls. 1–25.

Perry, G.
1811. Conchology, or the natural history of Shells: containing a new arrangement of the genera and species, &c. London. pp. 1–4, pls. 1–61.

Philippi, R. A.
1836–1844. Enumeratio Molluscorum Siciliae cum viventium tum in tellure tertiaria fossilium quae in itinare suo observit. (Title changes to: Fauna Molluscorum viventium et in tellure tertiaria fossilium regni utriusque Siciliae, for vol. 2.) vol. 1, xiv + 268 pp., pls. 1–12. Berlin (1836); vol. 2, iv + 303 pp., pls. 13–18 (1844a). Halis.
1841. Zoologische Bemerkungen. Archiv für Naturgeschichte, vol. 7, no. 1, pp. 42–50, Taf. 5.
1844b. Nachtrag zum zweiten Bande der Enumeratio Molluscorum Siciliae. Zeitschrift für Malacozoologie, vol. 1, pp. 100–112.
1848. Testaceorum novorum centuria. (Continuatio). Zeitschrift für Malakozoologie, vol. 5, no. 11, pp. 17–27.
1853. Handbuch der Conchyliologie und Malacozoologie. Halle. pp. i–xx, 1–547.

Piele, A. J.
1926. The molluscs of Bermuda [Presidential address]. Proceedings of the Malacological Society of London, vol. 17, pp. 71–98, 1 pl.

Pilsbry, H. A.
1922. Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo. Proceedings of the Academy of Natural Sciences of Philadelphia., vol. 73, pt. 2, pp. 305–428, pls. 16–47.

Pilsbry, H. A., and McGinty, T. L.
1945. Cyclostrematidae and Vitrinellidae of Florida, pt. 1. Nautilus, vol. 59, no. 1, pp. 1–13, pls. 1–2.

Pilsbry, H. A., and Olsson, A. A.
1945. Vitrinellidae and similar Gastropods of the Panamic province. Part 1. Proceedings of the Academy of Natural Sciences of Philadelphia., vol. 47, pp. 249–278, pls. 22–30.
1954. Systems of the Volutidae. Bulletins of American Paleontology, vol. 35, no. 152, 36 pp., 4 pls.

Pilsbry, H. A. and Sharp, B.
1897–1898. Scaphopoda. *in* **Tryon, G. W.**, Manual of Conchology. Ser. 1, 17 vols. Philadelphia.

Pinna, G. and Spezia, L.
1978. Catalogo dei Tipi del Museo Civico di Storia Naturale di Milano. V. I Tipi dei Gasteropoi fossili. Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale. Milano. vol. 119, pt. 2, pp. 125–180, pls. 5–68.

Plummer, F. B.
1933. The Geology of Texas. Pt. 3, Cenozoic systems in Texas. *in* **Sellars, E. H., Adkins, W. S., and Plummer, F. B.**, The Geology of Texas. vol. 1: Stratigraphy. University of Texas Publications, no. 3232, pp. 519–818.

Ponder, W. F.
1973. The origin and evolution of the Neogastropoda. Malacologia, vol. 12, no. 2, pp. 295–338, 5 text figs.

Ponder, W. F. and Warén, A.
1988. Classification of the Caenogastropoda and Heterostropha—a list of the family-group names and higher taxa. Malacological Review, suppl. 4, pp. 288–326.

Powell, A. W. B.
1942. The New Zealand recent and fossil mollusca of the family Turridae with notes on Turrid nomenclature and systematics. Bulletin of the Auckland Institute and Museum, no. 2, 188 pp., 14 pls.
1966. The molluscan families Speightiidae and Turridae: An evaluation of the valid taxa, both recent and fossil, with lists of characteristic species. Bulletin of the Auckland Institute and Museum, no. 5, 184 pp., 23 pls.
1969. The family Turridae in the Indo-Pacific. Part I. The subfamily Turrinae. Indo-Pacific Mollusca, vol. 1, no. 5, pp. 227–345, pls. 172–261.

Price, W. A., and Palmer, K. V. W.
1928. A new fauna from the Cook Mountain Eocene near Smithville, Bastrop County, Texas. Journal of Paleontology, vol. 2, no. 1, pp. 20–31, pls. 6–7.

Purdy, E. G.
1964. Sediments and substrates. *in* Imbrie, J. and Newell, N. D., *eds.*, Approaches to Paleoecology. Wiley, New York. pp. 238–272.

Rafinesque, C. S.
1814. Specchio delle Scienze o Giornale enciclopedico di Scilia; Deposito letterariodelle moderne cognizioni, scoperte ed osservazioni sopre le Scienza e Arti. Palermo. vol. 1, pp. 1–213; vol. 2, pp. 1–296.
1815. Analyse de la nature, ou tableau de l'univers et des corps organisés. Palermo. pp. 1–224.

Rang, S.
1829. Notice sur Litiope, *Litiopa* genre nouveau de Mollusque Gastéropode. Annales des Sciences Naturelles, vol. 16, pp. 303–307.

Raymondo-Granata, G.
1877. Sul Cirropterum semilunare Sars e del nuvo sottogenero Monophorus. vol. 3, 7 pp., 1 pl.

Reeve, L.
1843–1878. Concholigia Iconica: or, illustrations of the shells of Molluscous animals. London. Vols. 1–20, with suppl. to Conus [cont'd by G. B. Sowerby, beginning with genus

Pyramidella in vol. 15, Oct. 1865]. ; vol. 1, 122 pls. (1843–1846).

1844. Description of new species of *Ranella*. Proceedings of the Zoological Society of London, vol. 12, pp. 136–140.

Rehder, H. A.

1969. *Volutocorbis* and *Fusivoluta*, Two Genera of Deepwater Volutidae from South Africa.. The Veliger, vol. 11, no. 3, pp. 200–209, 4 pls.

Renick, B. C. and Stenzel, H. B.

1931. The lower Claiborne on the Brazos River, Texas. University of Texas Publications, no. 3101, pp. 73–108, pls. 6–7.

Richards, H. G.

1950. Geology of the Coastal Plain of North Carolina. Transactions of the American Philosophical Society, new ser., vol. 40, pt. 1, pp. 1–83, 76 pls.

Risso, A.

1826. Histoire naturelle des principales productions de l'Europe meridional et pariculièrement de celles des environs de Nice et des Alpes maritimes. Paris and Strasbourg. vol. 4, 439 pp., 12 pls.

Roch, F.

1931. *in* **Roch, F., and Moll, F.** Die Terediniden der Zoologischen Museum zu Berlin und Hamburg. Mitteilung aus dem Zoologischen Staatsinstitute und Zoologischen Museum in Hamburg.

Roch, F., and Moll, F.

1931. Die Terediniden der Zoologischen Museum zu Berlin und Hamburg. Mitteilung aus dem Zoologischen Staatsinstitute und Zoologischen Museum in Hamburg, vol. 44, pp. 1–22, figs. 1–2.

Röding, P. F.

1798. Museum Boltenianum. Hamburg. vol. 2, pp. 1–199.

Römer, E.

1864–69. Monographie der Molluskengattung Venus, Linné. Novitates conchologicae; Abbildung und Beschriebung neuer Conchylien, Suppl. 3, vol. 1, subgenus *Cythere* Lamarck. Kassel. pp. 1–217, pls. 1–59.

Rovereto, G.

1899. Primi ricerche sinonimiche sui gereri dei gasteropodi. Atti della Societa Ligustica de Scienze Naturali e Geografiche, vol. 10, pp. 101–110.

Russell, H.D.

1941. The Recent Mollusks of the Family Neritidae of the Western Atlantic. Bulletin of the Museum of Comparative Zoology, Harvard College, vol. 88, no. 4, pp. 348–404, pls. 1–7.

Sabine, E., Kirby, W., Gray, J. E., Konig, C. and Brown, R.

1824. A supplement to the appendix of Captain Parry's voyage for the discovery of a North-West Passage in the years 1819–20. Containing an account of the subjects of natural history. pp. 181–310, 5 pls. *in* **Parry, W. E.**, Journal of a voyage for the discovery of a North-West Passage from the Atlantic to the Pacific . . . 1819–20 &c. London. pp. 310, pls. 1–180.

Sacco, F.

1889–1904. I Molluschi dei terreni Tertiarii del Piemonte e della Liguria. Memorie della (Reale) Accademia della Scienze. Torino. Pt. 6: Volutidae, Marginellidae, Columbellidae, pp. 1–76, 2 pls. (1890); Pt. 10: Cassididae, Terebridae, Pusinellidae. 69 pp., 171 figs. (1891); Pt. 11: Eulimidae, Pyramidellidae. 100 pp., 320 figs. (1892); Pt. 17: Cerithiidae, Triforidae, Cerithiopsidae, Diastomidae. 86 pp., 370 figs. (1895).

Sagra, R. de la.

1839–1857. Histoire physique, politique et naturelle de l'Ile de Cuba. 12 vols and Atlas. Paris.

Sams, R. H.

1991. Stratigraphy of marine transgressive boundaries with the Gulf Coast Eocene Carrizo-Reklaw as an example. Unpublished PhD Thesis, University of Texas at Austin, pp. 1–180.

Sams, R. H. and Gaskell, B.

1990. Sequence Stratigraphy of the Reklaw Formation, Texas Gulf Coast: A Marine Transgressive Systems Tract of Eocene Age. *in* Barnette, S. C., *ed.*, Sequence Stratigraphy as an Exploration Tool: Concepts and Practices in the Gulf Coast. Eleventh Annual Research Conference of the Gulf Coast section SEPM, pp. 307–327.

Sars, G. O.

1878. Bidrag til Kundskaben om Norges Arktiske Fauna. I: Mollusca Regionis Arcticae Norvegiae. Oversigt over de i Norges arktiske region forekommende Blöadyr. Christiana. pp. i–xii, 466 pp., 52 pls., 1 map.

Sassi, A.

1827. Saggio geologico sopra il Bacino terziario di Albenga. Giornale Ligustico di Scienze, Lettere, ed Arti. Genova. vol. 1, pt. 5, pp. 467–484.

Scacchi, A.

1834–1835. Notizie intorno alle Conchiglie ed a zoofiti Fossile che si trovano nelle vicianze de Gravini in Pugilia. 3 pts, illust. Annali Civico Regio Due Sicilie, Tome 6, 7. Naples.

Schmidt, F. C.

1818. Versuch über die beste Einrichtung zur Aufstellung, Behandlung u. Aufbewahren der verschiedener Naturkorper u. Gegenstände der Kunste, vorzüglich der conchyliogischen Systeme u. Schriften, u. einer tabellischen Zuzammenstellung u. Vergleichung der besten u. neuesten conchyliogischen Systeme; nebst einen Verzeichniss der am meisten bekannten Conchylien, wie solche nach dem Lamarckschen Systeme geordnet werden können. Gotha. pp. 1–252.

Schubert, G. H., and Wagner, J. A.

1829. *in* **Martini, F. H. W., and Chemnitz, J. H.**, Neues systematisches Conchylien-Cabinet [Bd. 1–3] geordnet und beschrieben von F. H. W. Martini (fortgesetzt [Bd. 4–11] durch J. H. Chemnitz, [Bd. 12] G. H. Schubert . . . . A. Wagner, &c. 12 Bd. Bd. 8. pp. 12, + 1–356, pls. 1–68 (1784); Bd. 12. pp. 1-xii, 1–196, pls. 1–237 (1829).

Schilder, F. A.

1927. Revision der Cypraeacea (Mollusca, Gastropoda). Archiv für Naturgeschichte, vol. 91, pt. 10, pp. 1–171.

Scopoli, J. A.

1777. Indroductio ad historiam naturalem, sistens genera Lapidum, Plantarum et Animalum, &c. Pragae. pp. i–x, 1–506.

Schumacher, H. C. F.

1817. Essais d'une nouveau système des habitations des Vers testaces &c. Copenhagen. pp. i–iv, 1–287, 22 pls.

Sellars, E. H., Adkins, W. S., and Plummer, F. B.

1932. The Geology of Texas. vol. 1: Stratigraphy. University of Texas Publications, no. 3232. 1007 pp., 10 pls., 54 figs.

Semper, O.

1965. Du genre *Mathilda*. Journal de Conchyliogie, vol. 13, pp. 328–345.

Siesser, W. G.

1983. Paleogene Calcareous Nannoplankton Biostratigraphy: Mississippi, Alabama and Tennessee. Mississippi Geological Survey, Bulletin 125, pp. 1–61, 37 figs.

Smith, E. A.
1886. Summary of the lithological and stratigraphical features and subdivisions of the Tertiary of Alabama. Geological Survey of Alabama, Bulletin no. 1, 85 pp., 9 pls.

Smith, F. E.
1962. Upper Cretaceous and Lower Tertiary rocks in East Central Texas. Texas A&M College and Baylor Geological Society, Baylor University Press, Waco, Texas. 26 pp.

Smith, J. T.
1986. Middle Tertiary rocky substrate Mollusks from Baja California Sur, Mexico. Bulletin of the American Malacological Union, vol. 4, no. 1, pp. 1–12, pls. 1–3.

Smith, L. A.
1959. Recognition of Mio-Pliocene environments from megafaunas in well cuttings of southern Louisiana. Unpublished Master's Thesis, Texas Christian University, Fort Worth, Texas, 75 pp., 1 pl.
1962. Shallow marine and paleoenvironments, northern Gulf of Mexico. Proceedings of the First National Coastal and Shallow Water Research Conference, (Los Angeles, Oct. 1961), Tallahassee, Florida, Proc., pp. 673–675, 1 fig.
1965. Paleoenvironmental variation curves and paleoeustatics. Gulf Coast Association of Geological Societies, Transactions, vol. 15, pp. 47–60, 7 figs.

Sohl, N. F.
1960. Archeogastropoda, Mesogastropoda and Stratigraphy of the Ripley, Owl Creek, and Prairie Bluff Formations. United States Geological Survey Professional Paper 331-A, pp. 1–151, pls. 1–18.

Solander, G.
1776. Fossilia Hantoniensia collecta, et in Musaeo Britannico deposita a Gustavo Brander. London. pp. 1–43, pls. 1–9.

Soot-Ryan, T.
1955. A report on the family Mytilidae (Pelecypoda). Allen Hancock Pacific Expeditions, University of Southern California Press, Los Angeles, vol. 20, no. 1, 175 pp., 10 pls., 78 text figs.

Sowerby, G. B. II
1820–1825. The genera of recent and fossil shells for the use of students in Conchology and Geology. 2 vols. Part 19, 7 pp., 6 pls. (1823a).
1842–1887. Thesaurus Conchyliorum or monographs of genera of shells. 5 vols. vol. 1, pt. 4, pp. 1–146, pls. 32–40 (1844a).

Sowerby, J., and Sowerby, J. de C.
1812–1829. The Mineral Conchology of Great Britain; or coloured figures and descriptions of the remains of Testaceous Animals or Shells, which have been preserved at various times, depths in the earth. 7 vols. (J. Sowerby completed nos. 1–65, the remainder by J. de C. Sowerby). vol. 1, nos. 1–2, pp. 1–32, pls. 1–9 (1812); vol. 4, nos. 56–66, pp. 17–114, pls. 319–383 (1822); vol. 5, nos. 71–76, pp. 1–64, pls. 408–443 (1823b); vol. 5, nos. 77–83, pp. 65–138 pls. 444–485 (1824); vol. 7, nos. 110–112, pp. 25–56, pls. 629–643 (1844b).

Spath, L. F.
1927. Revision of the Jurassic cephalopod fauna of the Kachh (Cutch). Memoirs of the Geological Society of India. Pálaeontographica Indica, new ser., vol. 9, no. 2, pp. 1–71, pls. 1–7.

Spengel, J. W.
1881. Die Geruchsorgane und das Nervensysteme der Mollusken. Zeitschrift für Wissenschaftliche Zoologie, vol. 35, pp. 333–383, pls. 17–19.

Spoel, S. van der
1976. Pseudothecostomata, Gymnosomata and Heteropoda (Gastropoda). Bohn, Scheltema and Holkema. Utrecht. pp. 1–484, 246 figs.

Squires, R. L.
1987. Eocene Molluscan Paleontology of the Whitaker Peak area, Los Angeles and Ventura Counties, California. Natural History Museum of Los Angeles County, Contributions in Science, no. 388, pp. 1–93, 135 figs.

Starobogatov, Y. I.
1974. Xenoconchias and their bearing on the phylogeny and systematics of molluscan classes. Paleontological Journal. vol. 8, pp. 1–13 6 figs.

Steiner, G.
1992. Phylogeny and Classification of Scaphopoda. Journal of Molluscan Studies, vol. 58, pp. 385–400, 4 figs.

Stenzel, H. B.
1939. The Geology of Leon County, Texas. University of Texas Publications, no. 3818, 295 pp., 1 pl., maps.
1940. New Eocene brachiopods from the Gulf and Atlantic Coastal Plain and Tertiary Nautiloids from the Gulf Coastal Plain. University of Texas Publications, no. 3945, pp. 717–794, pls. 34–42.
1942. Type invertebrate fossils of North America. Cephalopoda, Eocene, Paleocene. Catalog of North American early Tertiary fossils of the Gulf and Atlantic Coastal Plain, University of Texas Publications, cards 1–28.
1950. Ball clay of the Troup district, Texas. University of Texas Publications, no. 5019, pp. 5–37, illust., map.
1953. The Geology of Henry's Chapel Quadrangle. Northeastern Cherokee County, Texas. University of Texas Publications, no. 5305, pp. 115, maps
1959. Cretaceous oysters of southwestern North America. International Geological Congress, 20th Session, Mexico City, Symposium del Cretacico, pp. 15–38.
1971. Oysters. *in* Moore, R. C., *ed.*, Treatise on Invertebrate paleontology. Part N, vol. 3 of 3, Mollusca 6, Bivalvia. Geological Society of America, pp. N953-N1124.

Stenzel, H. B., Krause, E. K. and Twining, J. J.
1957. Pelecypoda from the type locality of the Stone City Beds (Middle Eocene) of Texas. University of Texas Publications, no. 5704, 273 pp., 22 pls., 4 tab., 31 text figs.

Stenzel, H. B. and Turner, F. E.
1940. The gastropod genera *Cryptochorda* and *Lapparia* in the Eocene of the Gulf Coast Plain and Turritellidae from the Paleocene and Eocene of the Gulf Coast. University of Texas Publications, no. 3945, pp. 795–846, pls. 43–47.
1943. Gastropoda [family Turritellidae]. *in* Type invertebrate fossils of North America. Catalog of North American early Tertiary fossils of the Gulf and Atlantic Coastal Plain, University of Texas Publications, cards 41–121.

Stephenson, L. W.
1953. Probable Reklaw age of a ferruginous conglomerate in eastern Texas. United States Geological Survey Professional Paper 243-C, 42 pp., 2 pls., map.

Stephenson, M. B.
1942. A new Ostracode from the Claiborne Eocene of Texas. Journal of Paleontology, vol. 16, no. 1, pp. 105–115.
1944. New Ostracoda from subsurface middle Tertiary strata of Texas. Journal of Paleontology, vol. 18, no. 2, pp. 156–161.

Sterns, R. E. C.
1890. Descriptions of new West American land, fresh-water and marine shells, &c. Scientific results of explorations by the

U.S. Fish Commission Steamer "Albatross". Proceedings of the United States National Museum, vol. 13, pp. 205–225, pls. 15–17.

Stewart, R. B.

1927. Gabb's California fossil type gastropods. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 78, pp. 287–447, pls. 20–32.

1930. Gabb's California Cretaceous and Tertiary type lamellibranchs. Academy of Natural Sciences of Philadelphia, Special Publication no. 3, pp. 1–314, pls. 1–17.

Stoliczka, F.

1868. Cretaceous fauna from Southern India. vol. 2. The Gastropods of the Cretaceous rocks of southern India. Geological Survey India Memoirs, Palaeontographica Indica, pp. 204–498, pls. 17–28.

1870–1871. Cretaceous fauna (cont'd). vol. 3. The Pelecypoda, with a review of all known genera of this class, fossil and recent. Geological Survey India, Memoirs, Palaeontographica Indica. Pts. 1–4, pp. 1–222, pls. 1–12 (1870); Pts. 5–13, pp. 223–537, pls. 13–50 (1871).

Strong, A. M., and Hertlein, L. G.

1937. New species of Recent molluscs from the coast of western North America. The Templeton Crocker expedition of the California Academy of Sciences, no. 25, ser. 4, vol. 22, no. 6, pp. 159–178, pls. 34–35.

Sullivan, J. M. and Gardner, J. A.

1939. *in* **Gardner, J. A.,** Notes on fossils from the Eocene of the Gulf Province. United States Geological Survey Professional Paper 193-B.

Suter, H.

1913. Manual of the New Zealand Mollusca with an Atlas of Quarto Plates. Government of New Zealand, Wellington. pp. 1–1120, 71 pls.

1917. Descriptions of new Tertiary Mollusca occurring in New Zealand accompanied by a few notes on necessary changes in nomenclature. Part 1. Geological Survey of New Zealand, Bulletin 5, pp. 1–93, pls. 1–13.

Swainson, W.

1820–1833. Zoological Illustrations, or original figures and descriptions of new, rare, or interesting animals. Ser. 1, pls. 1–18 (1820); Ser. 1, pls. 19–83 (1821); Ser. 1, pls. 84–134 (1822); Ser. 1, pls. 135–182 (1823); Ser. 2, pls. 1–30 (1829); Ser. 2, pls. 31–45 (1830); Ser. 2, pls. 46–85 (1831); Ser. 2, pls. 86–96 (1832); Ser. 2, pls. 97–136 (1833).

1840. A Treatise on Malacology or the natural classification of Shells and Shell-fish. *in* The Cabinet Cyclopaedia. London. pp. 1–419, 130 figs.

Swanson, R. G.

1981. Sample Examination Manual. Methods in Exploration Series, American Association of Petroleum Geologists, Tulsa, OK. 99 pp.

Sykes, E. R.

1906. On the Mollusca procured during the "Porcupine" expeditions 1869–1870. Supplemental notes, pt. 2. Proceedings of the Malacological Society of London, pp. 173–190.

Taylor, D. W. and Sohl, N. F.

1962. An outline of Gastropod classification. Malacologia, vol. 1, no. 1, pp. 7–32.

Tegland, N. M.

1929. Correlation and affinities of certain species of *Pitaria.* University of California Publications in Geological Sciences, vol. 18, no. 10, pp. 275–290, pls. 21–23.

Thiele, J.

1912. Die antarktischen Schnecken und Muscheln. Deutsche Südpolar-Expedition 1901–1903. Pt. 13, pp. 183–286, pls. 11–19.

1925. Fünfter Stamm der Eumetazoa Mollusca-Weichtiere. *in* **Kuckenthal, W., and Krumbach, T.**, Handbuch der Zoologie, eine Naturgeschichte der Stämme des Tierreiches. Fünfter Band. Soenogastres. Mollusca. Echinodermata.

1931. Handbuch der Systematischen Weichtierkunde. Stuttgart. vol. 1, pp. 1–778, 783 figs.

Tomlin, J. R. le B.

1932. Reports on the marine mollusca in the collection of the South African Museum. VI–VIII. Annals of the South African Museum, vol. 30, pt. 2, pp. 157–169.

Toulmin, L. D.

1977. Stratigraphic Distribution of Paleocene and Eocene Fossils in the Eastern Gulf Coastal Region. Geological Survey Alabama, Monograph 13, vol. 1, 602 pp., 72 pls.

Troschel, F. H.

1848. *in* **Wiegmann, A. F. A.**, A. F. A. Wiegmann's und J. F. Ruthe's Handbuch der Zoologie. 3rd. ed., Umgearbeitet vermehrt und verbessert von Dr Franz Hermann Troschel und Frederich Ruth.

1853. Bericht über die Leistungen im Gebiet der Naturgeschichte der Mollusken während des Jahres 1853. Archiv für Naturgeschichte, bd. 2, pp. 90–140.

1856–1893. Dass Gebiss der Schnecken, zur Begrundung einer naturlichen Classification. Berlin. vol. 1, pp. 1–152, pls. 1–12 (1856–1858); vol. 1, pp. 153–238, pls. 13–20 (1861); vol. 1, pp. 239–246 (1863); vol. 2: pp. 1–409 (pp. 247–409 by Thiele), 32 pls. (1893).

Trowbridge, A. C.

1923. A geologic reconnaissance in the Gulf Coastal Plain of Texas, near the Rio Grande. United States Geological Survey Professional Paper 131, pp. 85–107.

Tryon, G. W.

1879–1898. Manual of Conchology. Ser. 1, 17 vols. Philadelphia. vol. 3. Tritonidae, Fusidae, Buccinidae. pp. 310, 87 pls. (1881); vol. 17, Scaphopoda. pp. 1–144 (1897), pp. 145–280 (1898), 39 pls. (1897).

1882–1884. Structural and Systematic Conchology. Philadelphia. vols. 1–3, pp.1–453, pls. 1–140.

Turner, R. D.

1966. A survey and illustrated catalogue of the Teredininae. Museum of Comparative Zoology, Harvard University. Occasional Papers on Mollusks, Spec. Publ., 265 pp., 25 text figs., 64 pls.

Vanetta, E. G.

1913. Descriptions of new species of Marine shells. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 65, pp. 22–27, 3 figs., pl. 2.

Verril A. E. and Bush, K. J.

1897. Revision of the genera of Ledidae and Nuculiade of the Atlantic coast of the United States. American Journal of Science, ser. 4, vol. 3, no. 13, pp. 51–63.

Vokes, E. H.

1968. Cenozoic Muricidae of the Western Atlantic Region. Part IV—*Hexaplex* and *Murexiella.* Tulane Studies in Geology and Paleontology, vol. 6, no. 3, pp. 85–126, pls. 1–8.

1970. Cenozoic Muricidae of the Western Atlantic Region. Part V—*Pterynotus* and. Tulane Studies in Geology and Paleontology, vol. 8, no. 1, pp. 1–50, *Poirieria* pls. 1–7.

1992. Cenozoic Muricidae of the Western Atlantic Region. Part IX—*Pterynotus, Poirieria, Aspella, Dermomurex, Calotrophon, Acantholabia,* and *Attilosa*; Additions and Cor-

rections. Tulane Studies in Geology and Paleontology, vol. 25, nos. 1–3, pp. 1–108, pls. 1–20.

Vokes, H. E.
1939. Molluscan Faunas of the Domengine and Arroyo Hondo formations of the California Eocene. Annals of the New York Academy of Sciences, vol. 38, pp. 1–246, pls. 1–22.

Voltz, M.
1830. Observations sur les Belemnites. Mémoires de la Société d'Histoire Naturelle de Strasbourg. Tome 1, pp. 1–72, pls. 1–8.

Vyalov, O. S.
1936. Sur la classification des huitres. Comptes Rendus (Doklady) de l'Académie des Sciences de l'URSS, new ser., vol. 4, no. 1, pp. 17–20.

Wade, B.
1926. The fauna of the Ripley Formation of Coon Creek, Tennessee. United States Geological Survey Professional Paper 137, pp. 1–272,

Wailes, B. L. C.
1854. Report on the agriculture and Geology of Mississippi . . . Jackson, Mississippi, 371 pp., 17 pls. Fossils of the Vicksburg Eocene beds. Described by T. A. Conrad, pp. 287 Fossil Testacea of the Tertiary green-sand and marl-bed of Jackson, Miss. Determined and named by T. A. Conrad, pp. 289, pls. 14–17.

Waller, T. R.
1972. The functional significance of some shell microstructures in the Pectinacea (Mollusca: Bivalvia). International Geological Congress, Twenty-fourth session, Montreal, Canada, Section 7, Paleontology, pp. 48–56.

Watelet, A.
1851–1856. Recherches dans les sables tertiaires des environs de Soissons. Société Historique, Archéologique et Scientifique de Soissons. vol. 5, 15 pp., 2 pls. (1851); vol. 6, 12 pp. (1853).

Watson, H.
1930. On the anatomy and affinities of *Plicatula.* Proceedings of the Malacological Society of London, vol. 19, pp. 25–30, 5 pls.

Weaver, C. E.
1916. Tertiary faunal horizons of western Washington. University of Washington, Publications in Geology. vol. 1, no. 1, 67 pp.

Weaver, D. W. and Molander, G. F.
1964. The Eocene faunal sequence in the eastern Santa Rosa Hills Santa Barbara County, California. University of California Publications in Geological Sciences, vol. 41, no. 3, pp. 161–248, 18 pls., 4 text figs.

Weisbord, N. E.
1929. Miocene Mollusca of northern Colombia. Bulletins of American Paleontology, vol. 14, no. 54, pp. 1–74, pls. 1–9.

Wendlandt, E. A. and Knebel, G. M.
1929. Lower Claiborne of East Texas, with special reference to Mount Sylvan dome and salt movements. Bulletin of the American Association of Petroleum Geologists, vol. 13, pp. 1351–1355, 7 figs.

Wenz, W.
1933–1944. Gastropoda. Allgemeiner Teil und Prosobranchia. *in* Schindewolf, O., *ed.*, Handbuch der Päleozoologie. Band 6. Teil 1, Allgemeiner Teil und Prosobranchia. Lfg. 1, pp. 1–240. Teil 2, Lfg. 3, pp. 241–480 (1938); Teil 3, Lfg. 4, pp. 481–720 (1939); Teil 4, Lfg. 6, pp. 721–960 (1940); Teil 5, Lfg. 7, pp. 961–1200 (1941); Teil 6, Lfg. 8, pp. 1201–1506 (1943); Teil 7, Lfg. 9, pp. i–xii, 1507–1639 (1944).

Wiegmann, A. F. A.
1848. A. F. A. Wiegmann's und J. F. Ruthe's Handbuch der Zoologie. 3rd. ed., Umgearbeitet vermehrt und verbessert von Dr Franz Hermann Troschel und Frederich Ruth. Berlin. pp. 1–651, 21 pls.

Whitfield, R. P.
1865. Descriptions of new species of Eocene fossils. American Journal of Conchology, vol. 1, no. 3, pp. 259–268, pl. 27.

Wood, S. V.
1842. A catalogue of the shells from the Crag [Gastropods]. Annals and Magazine of Natural History, vol. 9., pp. 455–462 + 527–544, 1 pl.

Woodring, W. P.
1925. Miocene Molluscs from Bowden, Jamaica. Part 1: Pelecypods and Scaphopods. Carnegie Institution of Washington, Publication. 366, 222 pp., 28 pls.
1928. Miocene molluscs from Bowden, Jamaica. Part 2: Gastropods. Carnegie Institution of Washington, Publication 385, pp. 1–564, 40 pls.

Wrigley, A.
1927. Notes on English Eocene Mollusca with descriptions of new species. II. The Fusinidae. Proceedings of the Malacological Society of London, vol. 17. pts. 5, 6, pp. 216–249, pls. 33–35.
1932. English Eocene species of *Sassia,* with a note on the Morphology of the Cymatiidae and the Bursidae. Proceedings of the Malacological Society of London, vol. 20, pt. 2, pp. 127–140, pls. 10–11.
1939. English Eocene *Surculites.* Proceedings of the Malacological Society of London, vol. 23, pt. 5, pp. 277–284, pl. 18.

Zilch, A.
1959–1960. Gastropoda. Euthyneura, in: Schindewolf, [ed.]. Handbuch der Palaeozoologie. Band 6. Teil 2, Lfg. 1 pp. 1–200. Teil 3, Lfg. 2, pp. 201–400 (1959); Teil 4, Lfg. 4, pp. 401–600 (1960).

Zittel, K. A. von
1895. Grundzüge der Paläontologie (Paläozoologie). München and Leipzig. 971 pp., 2048 figs.

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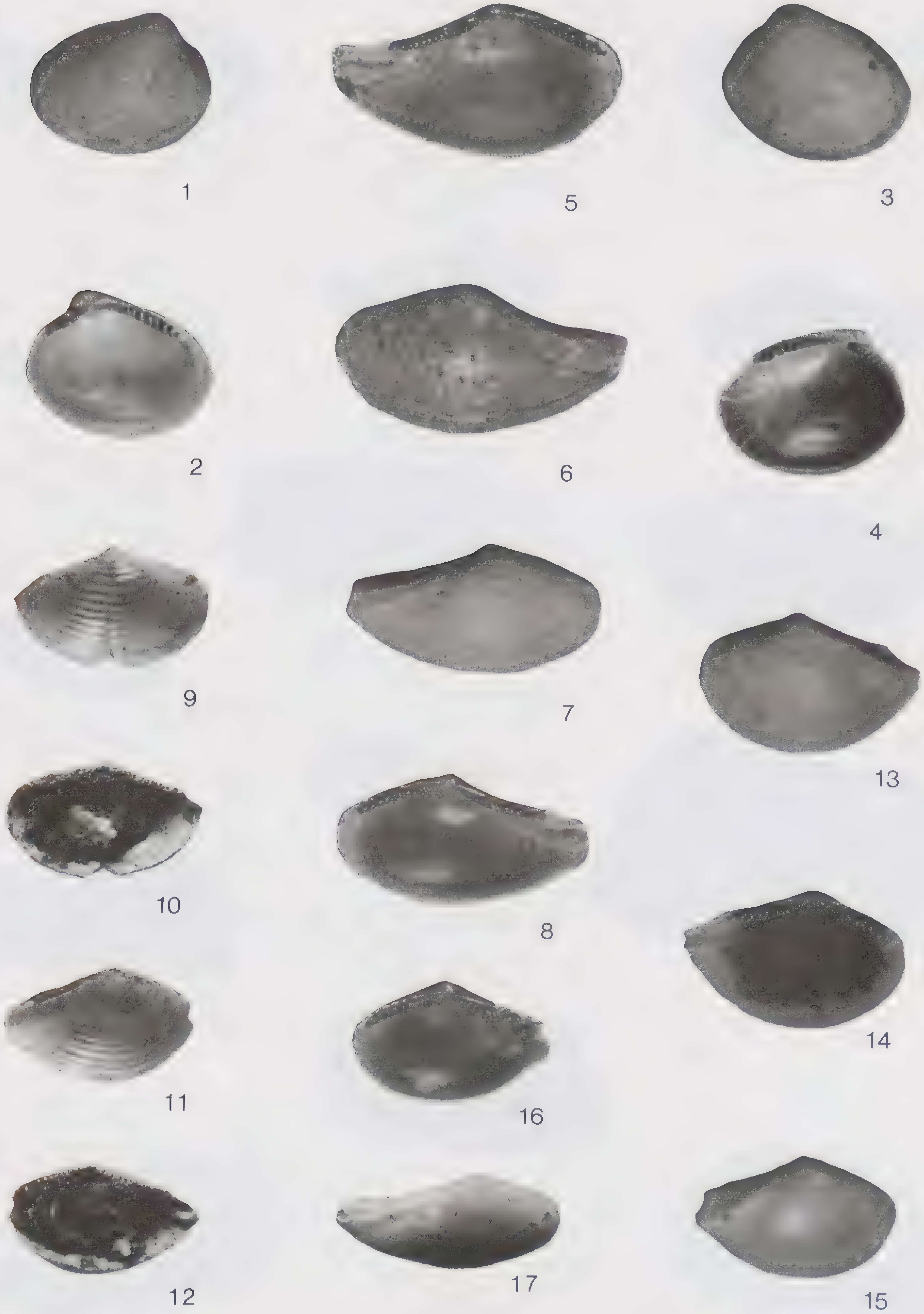
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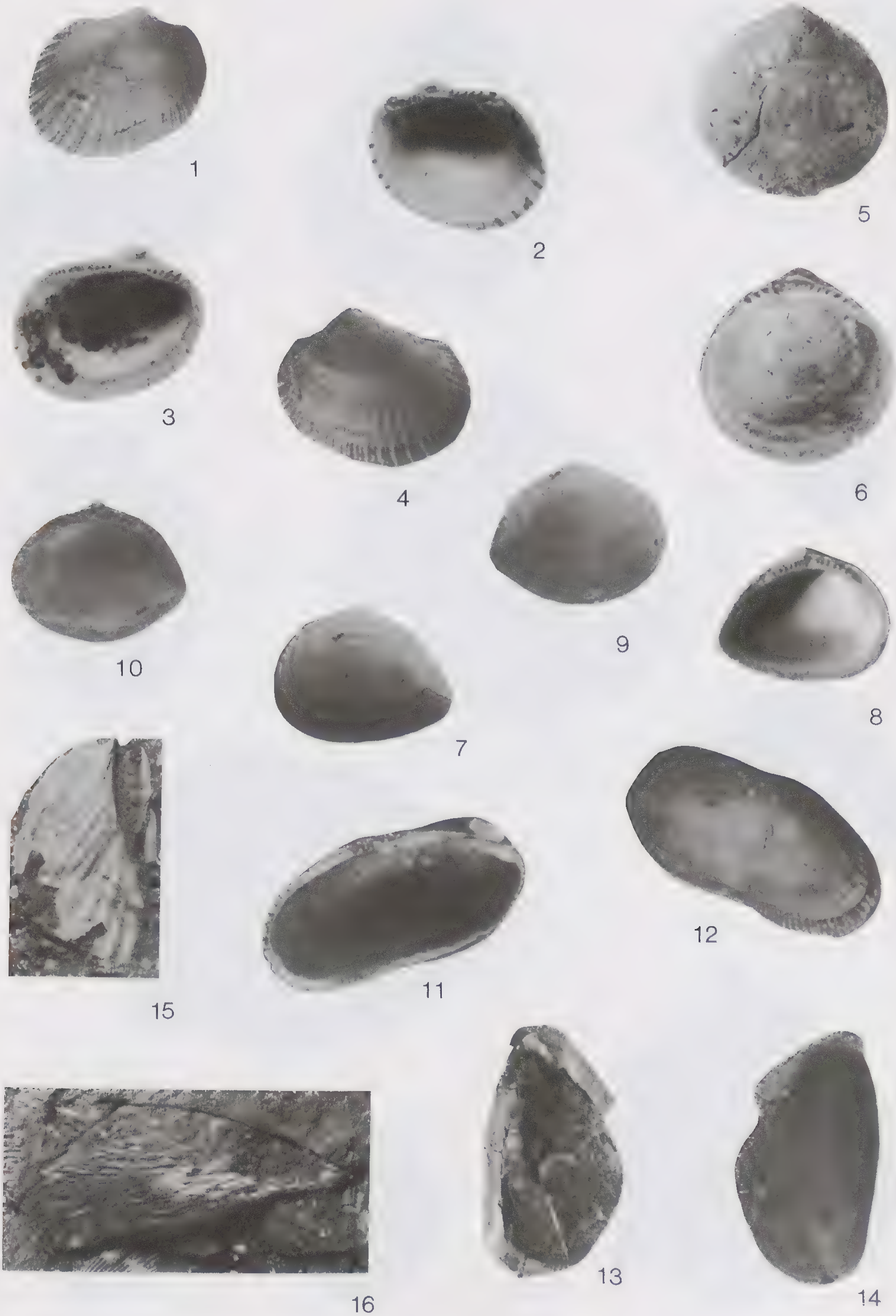
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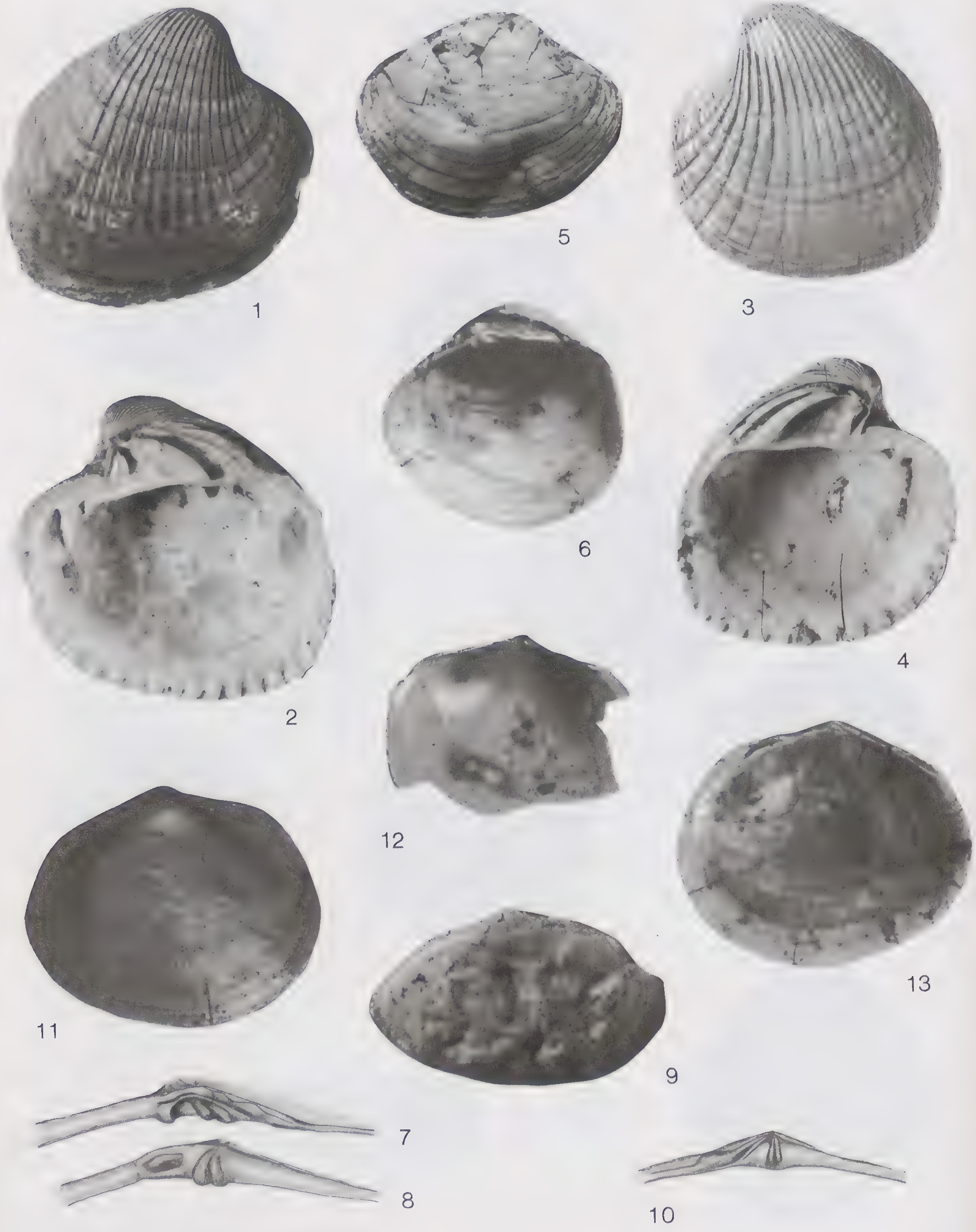

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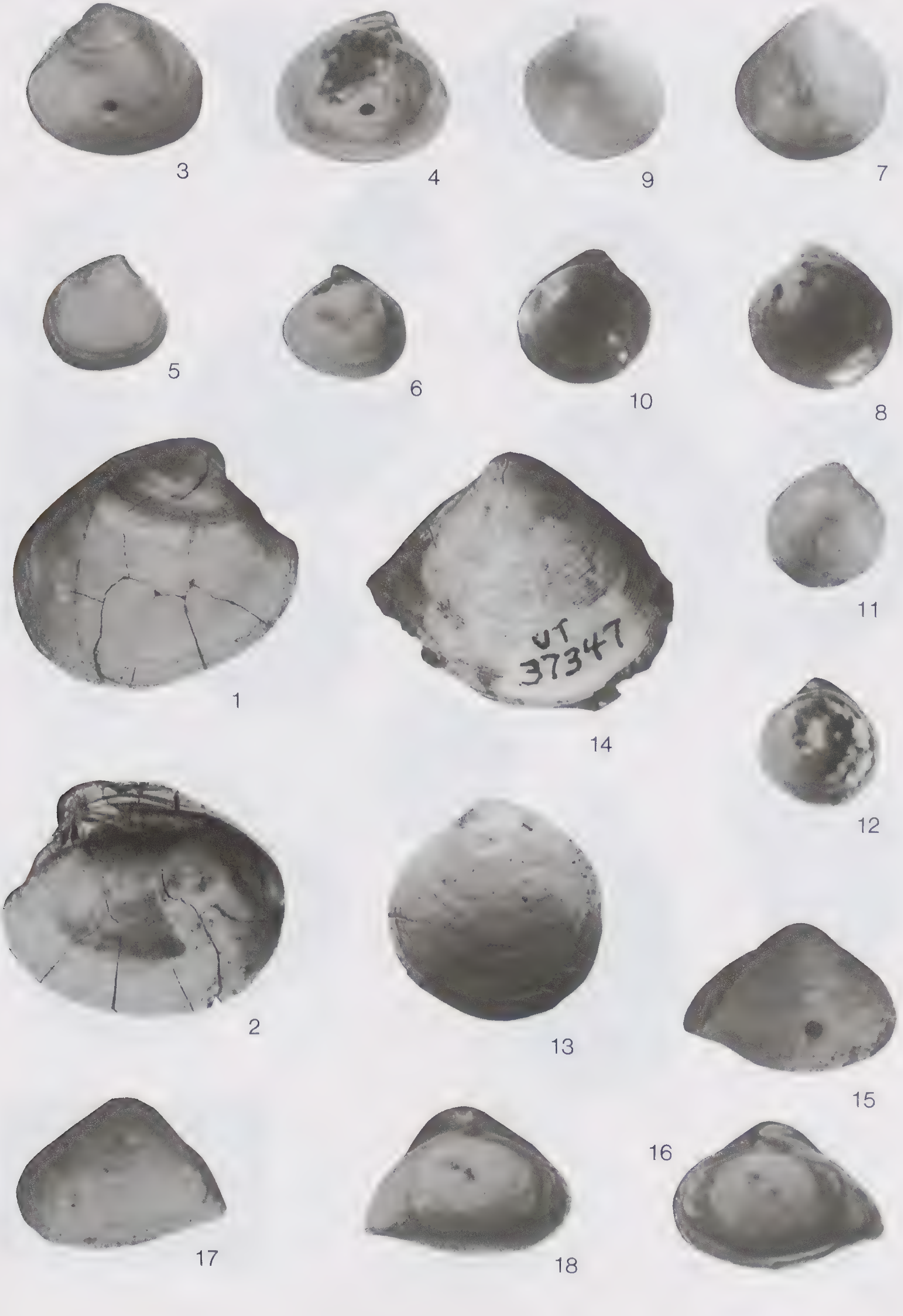
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13,14. External and internal views of a right valve, ×21 (PRI 33099).

15. ***Cochlodesma (Cochlodesma) ovalis,*** new species 43
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15. External view of a right valve, the holotype, ×5 (PRI 33097).

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18. ***Cardiomya*** sp. 44
Locality 7.
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3–5. ***Cadulus (?) bisissura,*** new species 46
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7–8. ***Episiphon gracilis,*** new species 45
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17–18. ***Solariorbis conicus,*** new species 53
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19–20. ***Solariorbis? parsnaticoides,*** new species 53
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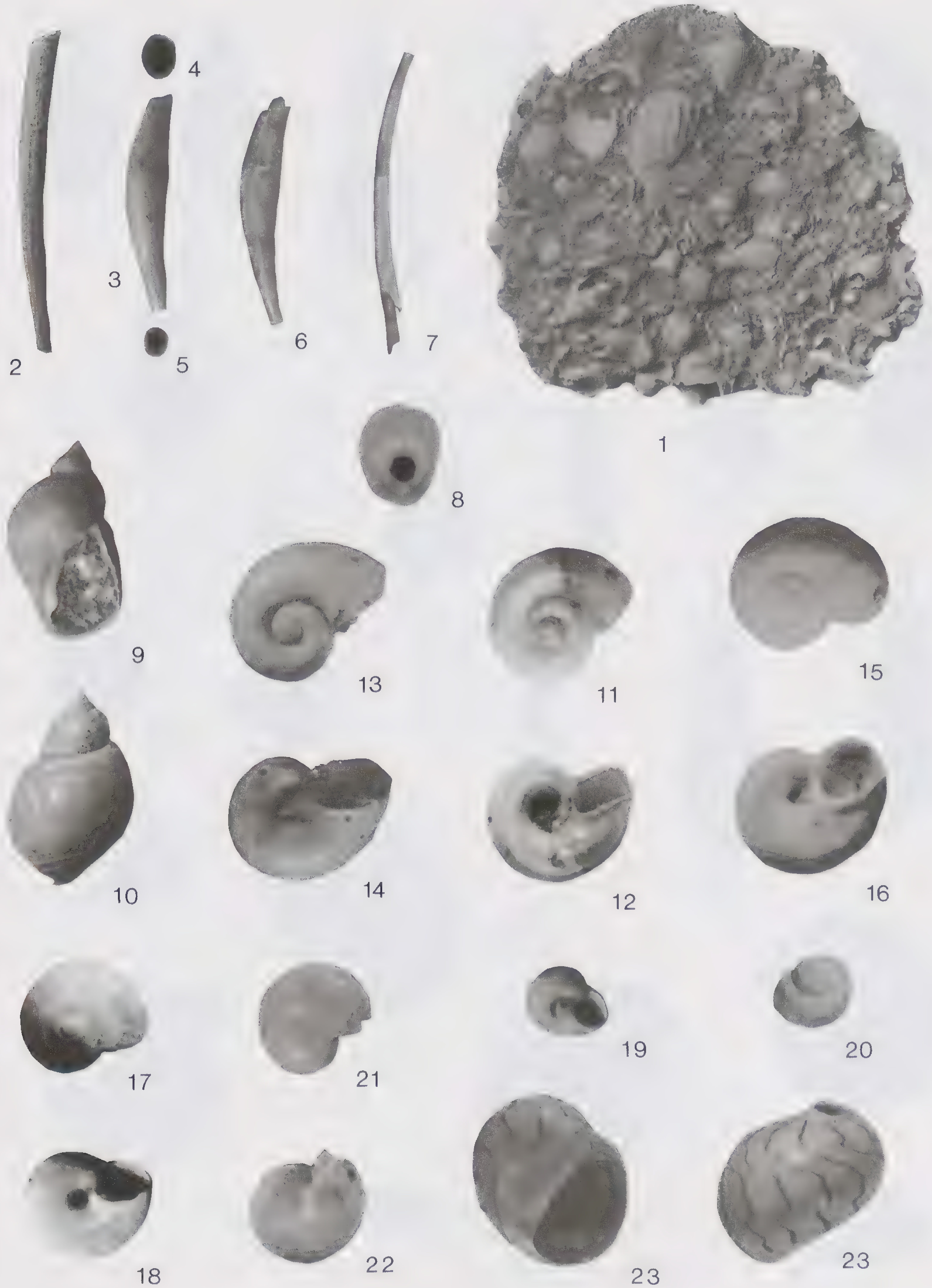
23–24. ***Theodoxus domicilium,*** new species 47
Locality 20.
23,24. Front and rear views of the holotype, ×6.6 (PRI 30328).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Locality 4.
1,2. Rear and front views of a Reklaw specimen, ×7.5 (PRI 30550).

3–4. ***Mathilda (Mathilda)*** cf. *retisculpta aldrichi* Palmer 106
Locality 4.
3,4. Front and rear views of a specimen complet with nucleus, ×8 (PRI 33104).

5–7. ***Mathilda (Echinimathilda?) cribraea,*** new species 107
Locality 4.
5,6. Rear and front views of the holotype, ×8.5 (PRI 30329).
7. Side view of a fragment of a larger specimen, a paratype, ×8.5 (PRI 30330).

8–9. ***Mathilda (Fimbriatella) iugum,*** new species 107
Locality 4.
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10–11. ***Bittium ridgei,*** new species 49
Locality 4.
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12–14. ***Glyptozaria americana,*** new species 108
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12,13. Front and rear views of the holotype, ×7.3 (PRI 33078).
14. View of the paratype showing the protoconch, ×9 (PRI 33079).

15–16. ***Bittium tresquatrum,*** new species 49
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15,16. Rear and front views of the holotype, ×5 (PRI 30331).

17. ***Mathilda (Mathilda)*** cf. *claibornensis* Aldrich 106
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17. Rear view of a fragment, ×9 (PRI 30415).

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18,19,20. Top, basal and apertural views of the holotype, ×4.3 (PRI 30336).

21–23. ***Pseudomalaxis? acuta,*** new species 109
Locality 20.
21,22,23. Top, basal and apertural views of the holotype, ×8.1 (PRI 30291).

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2. Cross-section of a paratype, ×2.2 (PRI 30340).

3 5. ***Architectonica (Patulaxis?) fimbriaea,*** new species 110
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6 8. ***Architectonica (Granosolarium) aldrichi caterva,*** new subspecies 110
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9–10. ***Architectonica (Granosolarium) geminicostata*** new species 111
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16. Views of the holotype, a portion of a tube, ×4.25 (PRI 30345).
17. View of a paratype, a portion of a tube, ×4.25 (PRI 30346.

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10–11. ***Amaurellina plummeri,*** new species 57
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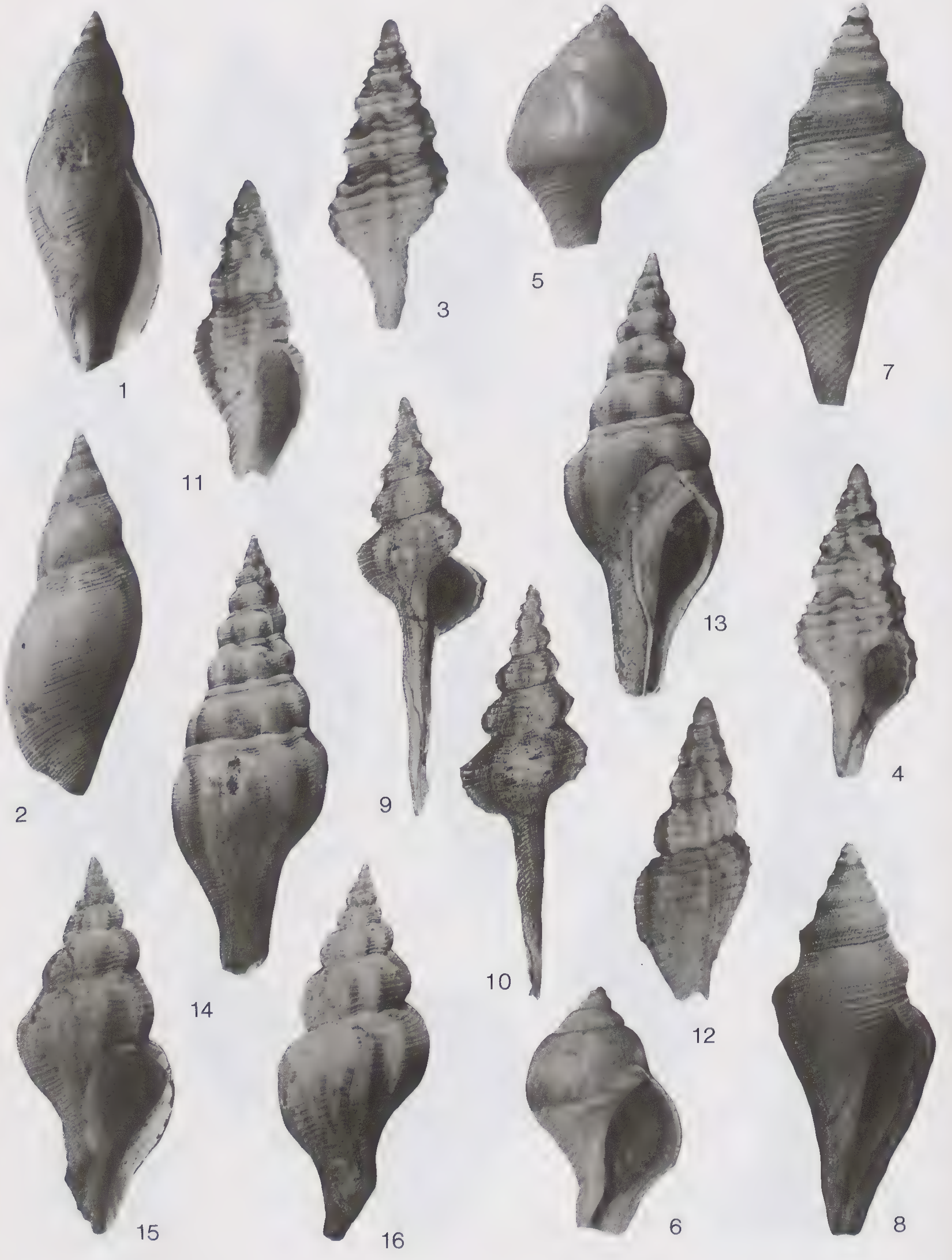
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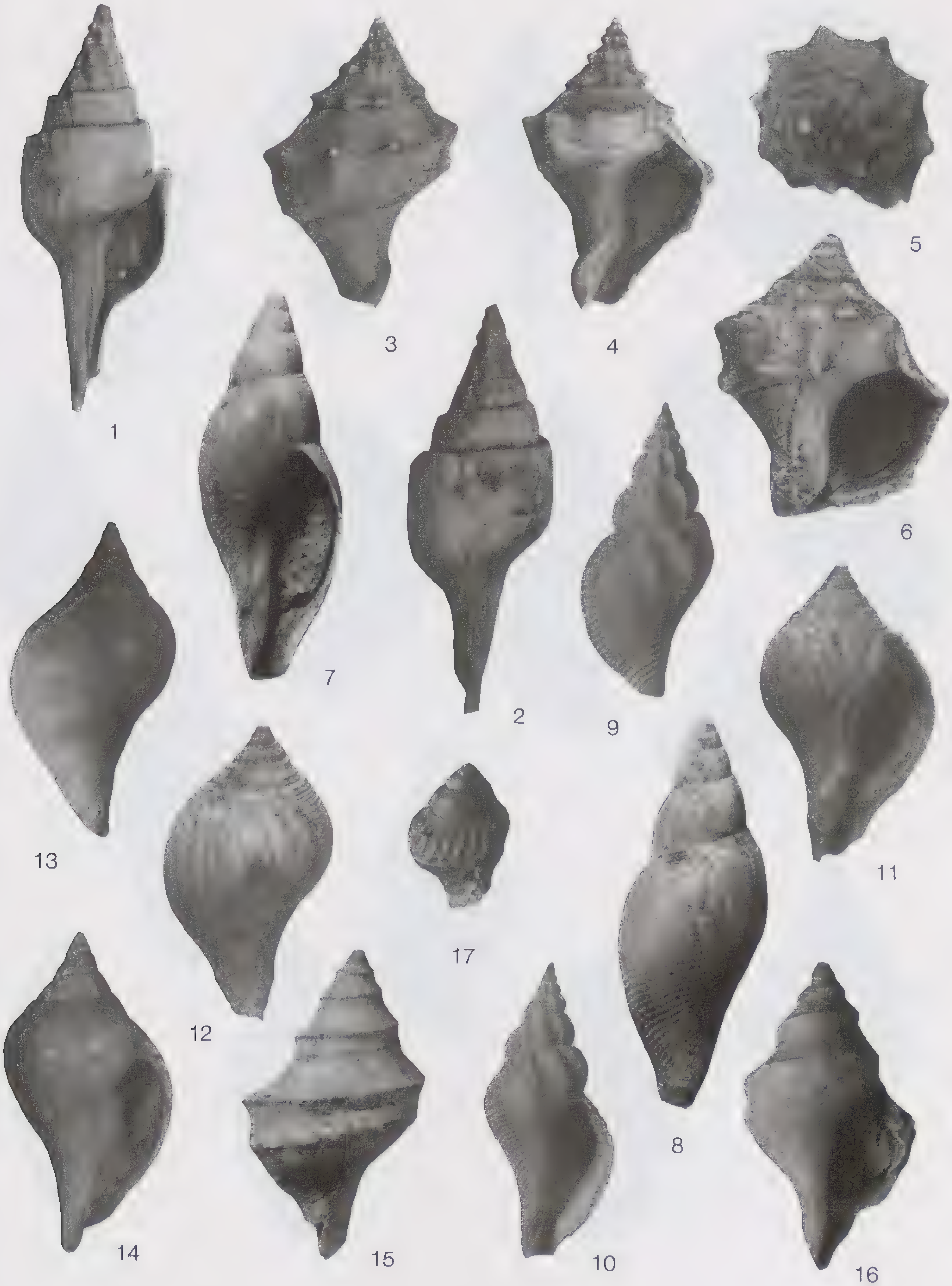
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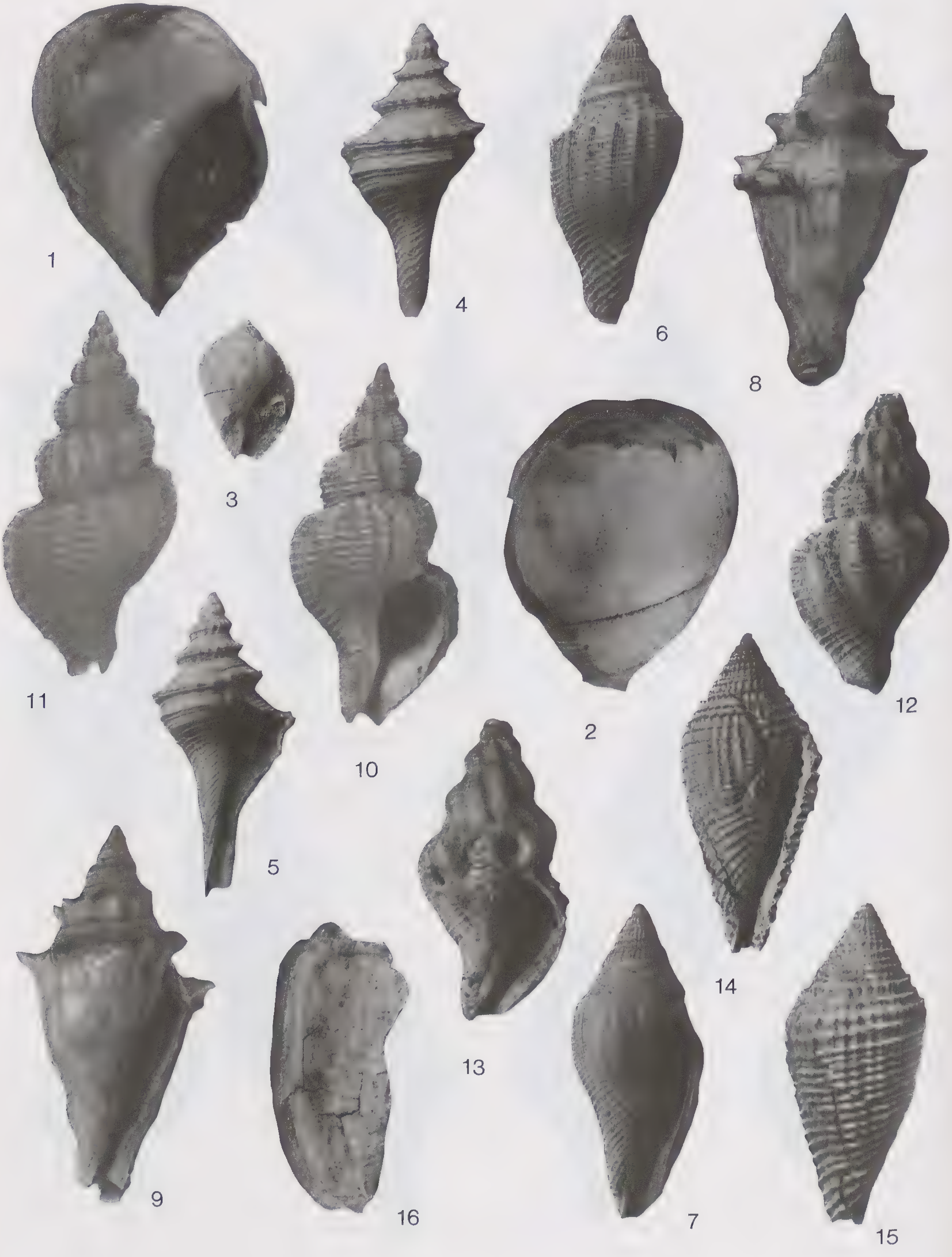
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9–10.	***Conus (Lithoconus) nocens,*** new species	90
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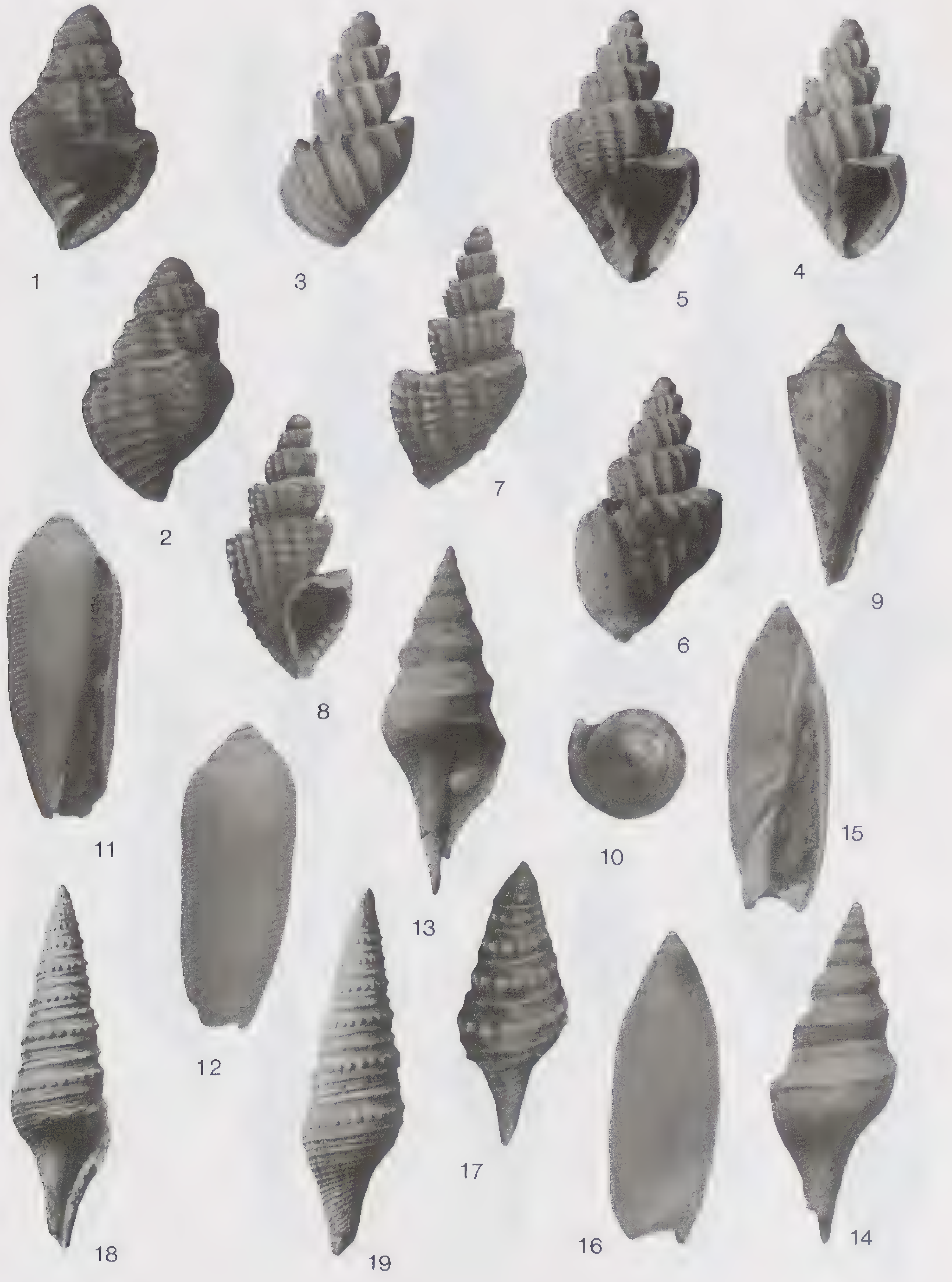
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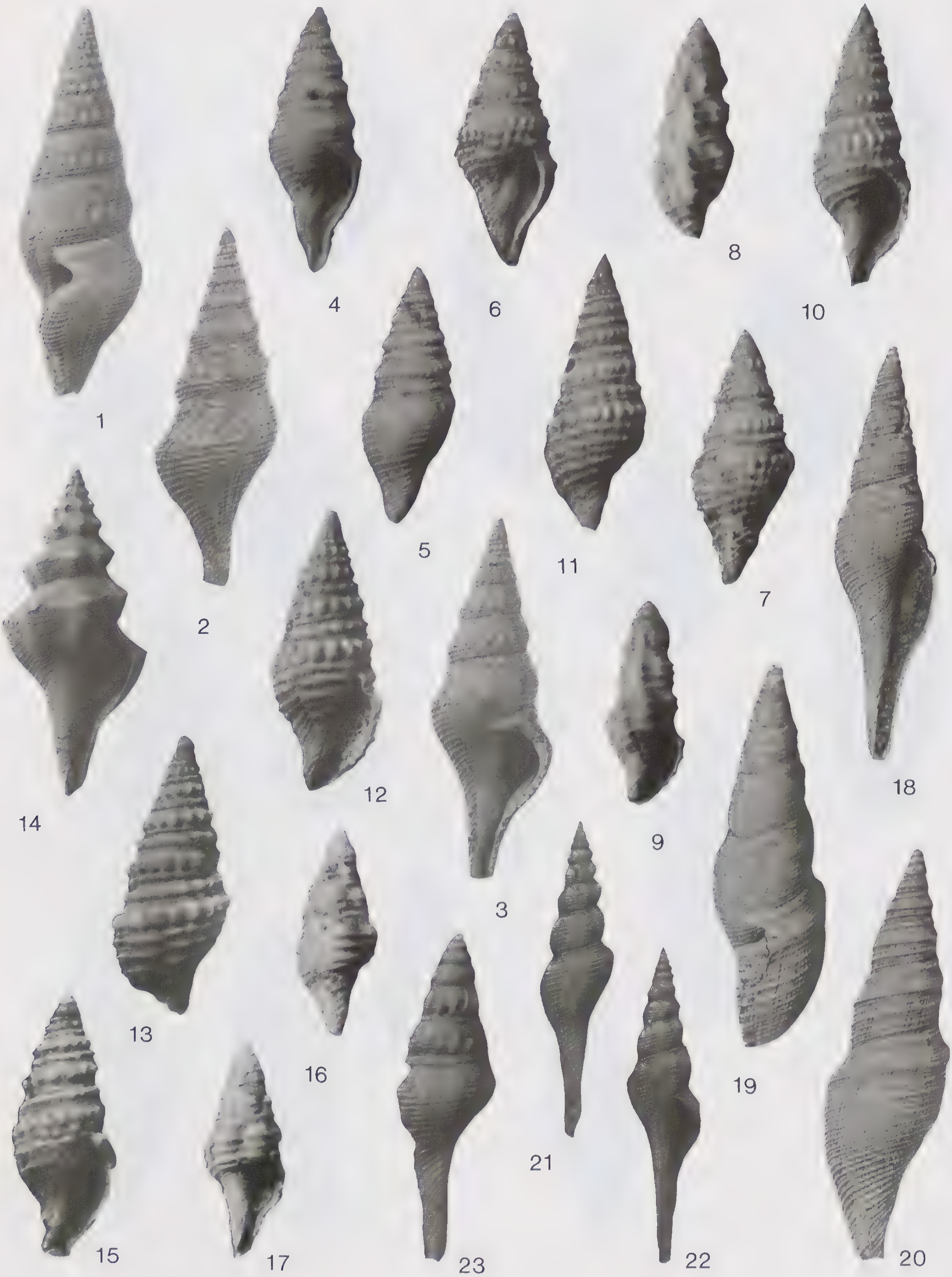
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1–3. ***Hesperiturris nodocarinatus crassus***, new subspecies 98
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2,3. Rear and front views of the holotype, ×3.2 (PRI 30449).
1. View of a paratype, ×4.7 (PRI 30450).

4–5. ***Bathytoma*** cf. *nonplicata* Harris 100
Locality 4.
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6–7. ***Domenginella ridgei***, new species 100
Locality 4.
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8–9. ***Pyramimitra (Petrafixa) eocenica***, new species 92
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10–11. ***Coronia*** cf. ***margaritosa*** Casey 98
Locality 4.
10,11. Rear and front views of the Reklaw specimen, ×6 (PRI 33186).

12–13. ***Hesperiturris***? ***monilis***, new species 99
Locality 4.
12,13. Front and rear views of the holotype, ×6.2 (PRI 30454).

14. ***Surculoma (Volutapex) imbricata***, new species 91
Locality 20.
14. Front view of the holotype, ×2.3 (PRI 30460).

15. ***Hesperiturris***? ***monilis laeva***, new subspecies 99
Locality 4.
15. Front view of the holotype, ×7.7 (PRI 30448).

16–17. ***Lyrosurcula*** cf. *vaughani* (Harris) 92
Locality 20.
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18–20. ***Eosurcula moorei reklawensis***, new subspecies 94
Locality 20.
18. Front view of the holotype, ×5.3 (PRI 30470).
19. View of a paratype showing the sinus, ×3.75 (PRI 30471).
20. Rear view of a paratype, ×4.4 (PRI 30472).

21–22. ***Pleurofusia***? **huppertzi** (Harris) 93
Locality 8.
21,22. Rear and front views of a Reklaw specimen, ×1.6 (PRI 30505).

23. ***Leptosurcula carinata***, new species 94
Locality 4.
23. Front view of the holotype, ×9.3 (PRI 30466).

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1–2. ***Tropisurcula (Tropisurcula) milamensis,*** new species 95
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1,2. Rear and front views of the holotype, ×5.8 (PRI 30478).

3–4. ***Tropisurcula (Eodrillia) planus*** new species 96
Locality 20.
3,4. Rear and front views of the holotype, ×4.6 (PRI 30473).

5–6. ***Tropisurcula (Eodrillia) grandis,*** new species 96
Locality 4.
5,6. Rear and front views of the holotype, ×5.6 (PRI 30478).

7–8. ***Protosurcula*? *aurora,*** new species 96
Locality 20.
7. Rear view of the holotype, ×1.8 (PRI 30483).
8. Front view of a paratype, ×2.6 (PRI 30484).

9–11. ***Eocythara texana,*** new species 103
Locality 20.
9,10,11. Front, rear and side views of the holotype, ×10 (PRI 30489).

12–13. ***Microdrillia rostratula*** Casey 101
Locality 20.
12,13. Front and rear views of a Reklaw specimen, ×6.8 (PRI 30567).

14–15. ***Microdrillia*** aff. *robustula* Casey 101
Locality 20.
14,15. Front and rear views of a Reklaw specimen, ×7.3 (PRI 33110).

16–17. ***Spirotropis claibornica,*** new species 102
Locality 4.
16,17. Rear and front views of the holotype, ×8 (PRI 30488).

18–19. ***Eocythara lineata,*** new species 103
Locality 20.
18,19. Rear and front views of the holotype, ×11.6 (PRI 30494).

20–21. ***Microdrillia*** sp. 101
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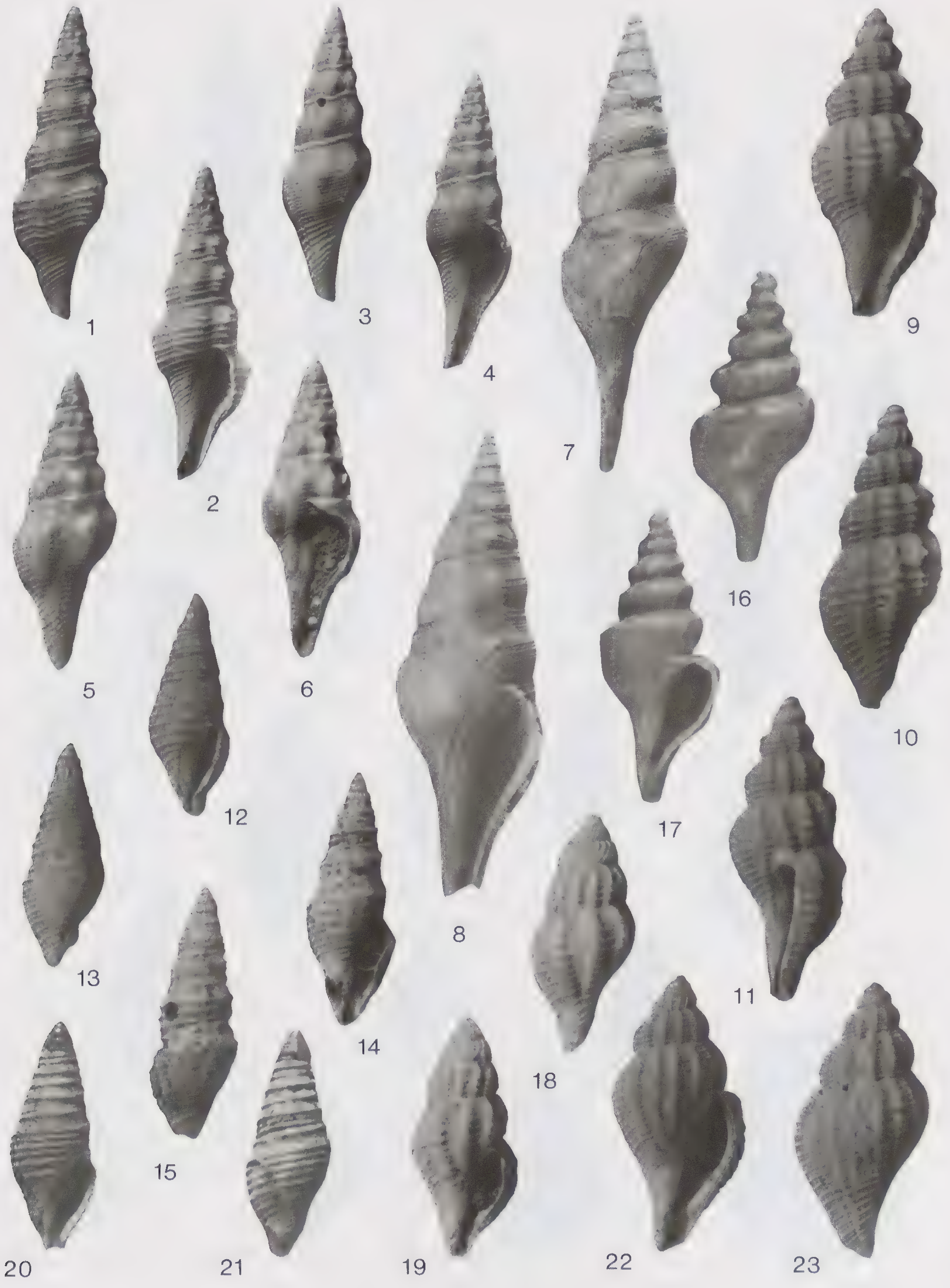
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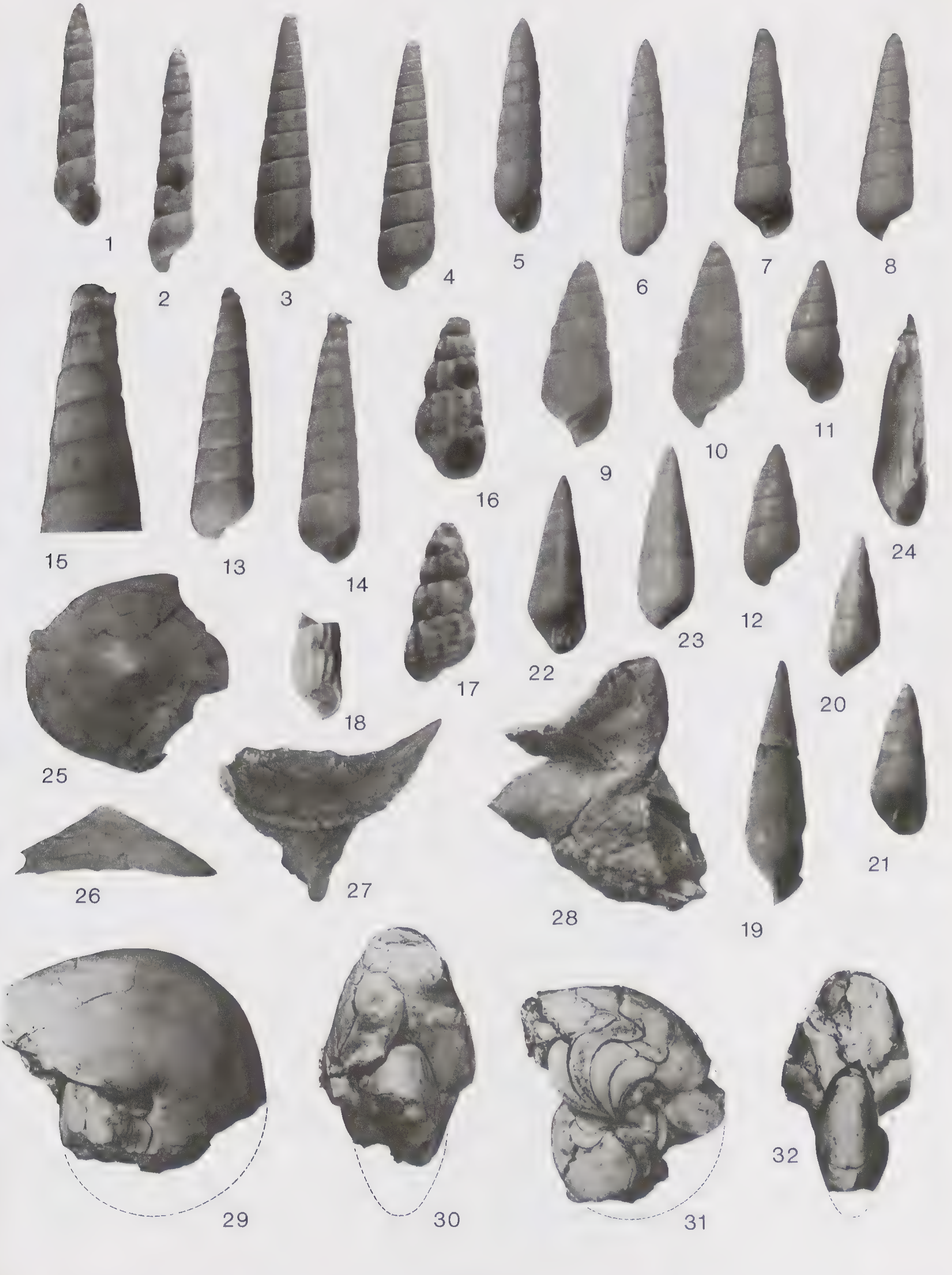
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Table 1.—Composition of the Reklaw fauna from Joe Taylor Branch (TB) and Ridge Creek (RC); the relative abundance of each species (a = abundant; c = common; u = uncommon; r = rare); and the inferred habitat of each species. See text (p. 18) for details and references.

Species	TB	RC	Habitat of closest living relatives
SCAPHOPODA			
Dentalium (Antalis) palmerae n. sp.	a	c	Bay and pass to abyssal
Fustiaria (Episiphon) aciculata n. sp.	c	a	Middle neritic to slope
Cadulus bisissura n. sp.	r	r	Middle neritic to slope
Cadulus (Polyschides) aff. *subcoarcuatus* (Gabb,1860)		r	Fathoms, middle neritic to slope
BIVALVIA			
Nucula cochlear n. sp.	c	c	Neritic
Nucula (Nucula) aff. *smithvillensis* Stenzel & Twining, 1957	r		Neritic
Nuculana (Jupiteria) turgeo n. sp.	c	c	Beach to inner neritic
Nuculana (Saccella) demissa n. sp.		r	Beach to inner neritic
Litorhadia milamensis n. sp.	r		Neritic
Litorhadia undulata n. sp.	c	c	Neritic
Litorhadia valdefragilis n. sp.	r	c	Neritic
Litorhadia sp.	r		Neritic
Orthoyoldia psammotaea vivianensis (Harris,1919)	r	u	Neritic
Barbatia (Acar) salebrosus n. sp.	r	r	Inner to middle neritic
Barbatia (Cucullaearca) reklawensis n. sp.	r	u	Inner to middle neritic
Bathyarca claibornica n. sp.	r	r	Outer neritic to slope
Pachecoa (Pachecoa) concentrica n. sp.	u	r	Shallow inner neritic
Glycymeris sp.	r		Neritic
Mytilus (Crenomytilus) sp.		r	Intertidal, attached
Gregariella ridgei n. sp.		r	Inner neritic boring in coral
Atrina? sp.	r		Inner neritic, in sand and mud
Pteria (Pteria) cf. *petropolitana* Stenzel & Twining, 1957	u		Intertidal to middle neritic
Pteria sp.		r	Intertidal to middle neritic
Amusium (Propeoamusium) zinguli n. sp.	r	u	Middle neritic, slope
Plicatula pustula n. sp.	c	c	Intertidal to middle neritic
Hyotissa offemanae n. sp.		r	Outer neritic
Anodontia (Eophysema) reklawensis n. sp.	u		Tidal channel to midle neritic
Anodontia sp.		r	Tidal channel to middle neritic
Chama taylorensis n. sp.	c	c	Outer neritic, cemented
Venericor densata reklawensis n. sp	c	c	Shallow neritic
Claibornicardia milamensis n. sp.	u	c	Shallow neritic
Claibornicardia milamensis linguinodifera n. sp.	r		Shallow neritic
Tenuimactra hodgkinsoni n. gen. n. sp.	r	r	Middle to outer neritic
Eosolen shirleyi n. sp.	r		Intertidal to neritic
Tellina (Eurytellina?) milamensis n. sp.	r		Bay to slope
Arcopagia (Arcopagia) trumani Harris,1897	r		Neritic
Lutetia texana reklawensis n. sp.	c		Bay to inner neritic
Alveinus cf. *minutus* Conrad, 1865	r	r	Bay to inner neritic
Pitar (Calpitaria) turneri n. sp.		r	Bay to inner neritic
Pitar (Katherinella?) sp.		r	Bay to inner neritic
Caryocorbula marquezensis n. sp.	c		Middle to outer neritic
Notocorbula marquezensis n. sp.	a	a	Middle to outer neritic
Panopea (?) sp.	r	r	Intertidal to shallow neritic
Bankia (Lyrodobankia) petalus n. sp.	r		Wood borer, pelagic
Pholadomya cf. *leonensis* Stenzel & Twining, 1957	r	r	Neritic?
Cochlodesma (Cochlodesma) ovalis n. sp.	r	r	Pass, neritic?
Cardiomya? fredsmithi n. sp.	r	r	Outer neritic to slope
Cardiomya? sp.	r	r	Outer neritic to slope
Verticordia (Trigonulina) cf. satex Gardner, 1927		r	Outer neritic to slope
GASTROPODA			
Theodoxus domicilium n. sp.	r		Fluvatile to intertidal
Litiopa texana n. sp.	c	c	Pelagic
Bittium (Bittium) tresquatrum n. sp.	a	u	Tidal flats to inner neritic
Bittium (Bittium) ridgei n. sp.		u	Middle to outer neritic
Turritella turneri Plummer, 1933		c	Tidal flats, lagoon, beach, to inner neritic
Littorina (Prosthenodon) eofasciata n. sp.		r	Intertidal to shallow neritic
Cyclostremiscus axacuus (Conrad,1833)	r	r	Intertidal to inner neritic
Tubiola gracilis n. sp.	r	r	Outer neritic?
Solariorbis discoides n. sp.	c	c	Intertidal to inner neritic
Solariorbis conicus n. sp.		c	Intertidal to inner neritic
Solariorbis? parsnaticoides n. sp.	u		Intertidal to inner neritic
Teinostoma cf. *texanum* Palmer,1937	r		Intertidal to inner neritic
Ectinochilus sp.		r	Pass to slope
Postalia americana n. sp.	r	r	Inner to middle neritic, parasitic?
Serpulorbis? multiclavus n. sp.		u	Low intertidal
Neosimnia scobina n. sp.	r	r	Shallow to inner neritic, also reef dweller
Cypraeorbis bulbus n. sp.	r	r	Shallow to inner neritic, also reef dweller
Amaurellina plummeri n. sp.		c	Middle neritic
Natica (Naticarius) brevisulcata n. sp.	c	c	Inner neritic, tidal channel
Natica (Carinacca) moffitti n. sp.	c	u	Inner neritic, tidal channel
Polinices (Pliconacca) onustus reklawensis n. subsp.	c	c	Pass to outer neritic
Sinum taylori n. sp.	c	c	Middle neritic
Sinum moveum n. sp.	u	c	Middle neritic
Galeodea (Mambinas) turneri Gardner,1939	r	u	Intertidal to middle neritic?
Phalium (Semicassis) reklawensis n. sp.	u	u	Middle neritic to outer neritic?
Ficopsis nucleoides n. sp.	c	a	Pass to slope
Cerithiopsis (Cerithiopsina) sp.		r	Bay to inner neritic
Amaea (Scalina) macula n. sp.	u	c	Outer neritic
Amaea (Foratiscala) texana n. sp.		r	Middle to outer neritic
Rugatiscala cooperi n. sp.	r		Middle to outer neritic
Rugatiscala? sp.	r		Middle to outer neritic
Melanella minutissima n. sp.	r		Inner to outer neritic
Melanella cf. notata (I. Lea,1833)	r	r	Inner to outer neritic
Hexaplex eoa n. sp.		r	Pass to middle neritic?
Pterynotus (Pterynotus) cf. *stenzeli* Vokes,1970		r	Pass to middle neritic?
Mitrella (Clinurella) nuttalli n. sp.	r	u	Middle bay to middle neritic
Mitrella (Clinurella) nuttalli lineata n. sp.	r	c	Middle bay to middle neritic
Metula elongatoides n. sp.		r	Inner neritic
Pseudometula gradus n. gen. n. sp..		c	Inner neritic
Distorsio nucleoides n. sp.	r	c	Beach to middle neritic
Colwellia bilineata n. sp.	r	a	Intertidal to inner neritic?
Colwellia sp.	r		Intertidal to inner neritic?
Tritiaria nodosa n. sp.	a	a	Intertidal to inner neritic?
Antillophos multilineatum n.sp.	r	r	Inner to outer neritic
Buccinanops ellipticum reklawensis n. subsp.	u		Intertidal to inner neritic?
Bullia altilis harrisi n. sp.	r		Intertidal to inner neritic?
Falsifusus ottonis (Aldrich,1886)	c	c	Inner to middle neritic?
Fusinus claibornica n. sp.	r	u	Low tide to outer neritic
Latrius (Polygona) traceyi n. sp.		r	Middle to outer neritic
Terebrifusus multiplicatus (H. C. Lea, 1841)		r	Middle to outer neritic
Mazzalina conica n. sp.	r		Intertidal to inner neritic?
Surculites lapillus n. sp.	r	r	Beach, bay, inner neritic?
Clavilithes parvetorbis n. sp.	c	u	Middle neritic?
Clavilithes? acus n. sp.	r		Inner to middle neritic
Levifusus? serrae n. sp..	r	u	Inner to outer neritic?
Cornulina minax dockeryi n. sp.	r	r	Intertidal, reef dweller?
Sycostoma texana n. sp.	r		Middle neritic
Strepsidura harrisi Givens and Garvie, 1993	u	r	Beach to inner neritic
Euryochetus punctatum n. sp.		r	Inner neritic
Laevibuccinum lineatum Heilprin,1881	r	a	Intertidal to inner neritic?
Michela trabeatoides carinata n. subsp.	u	u	Middle to outer neritic
Pseudoliva cf. *santander* Gardner,1945	c	r	Bay, intertidal, inner neritic?
Siphonalia cf. *plummeri* Palmer,1937	r		Middle to outer neritic
Volutocorbis stenzeli Plummer, 1933	c	a	Inner to middle neritic?
Athleta petrosus smithi Fisher & Rodda, 1964	a	a	Inner to outer neritic
Cryptochorda sp.	r		Inner neritic?
Ancilla (Olivula) staminea reklawensis n. subsp.	c	a	Beach, inner neritic
Admetula irregularis n. sp.		u	Middle neritic to slope?
Trigonostoma (Ventrilia) herbae n. sp.	c	c	Middle neritic to slope
Trigonostoma (Ventrilia) elegantissima n. sp.	r	r	Middle neritic to slope
Trigonostoma (Ventrilia) jonesae n. sp.	r		Middle neritic to slope
Volvariella milamemsis n. sp.	u		Beach, inner neritic
Conus (Lithoconus) nocens n. sp.	r		Intertidal to middle neritic
Turricula sp.	r		Outer neritic
Surculoma imbricata n. sp.	c	a	Middle to outer neritic
Lyrosurcula cf. *vaughani* (Harris, 1895)	r		Middle to outer neritic
Pyramimitra (Petrafixa) eocenica n. sp.	r	r	Middle to outer neritic
Pleurofusia? huppertzi (Harris, 1895)	a	a	Middle to outer neritic
Leptosurcula carinata n. sp.		r	Middle to outer neritic
Eosurcula moorei reklawensis n. sp.	c	a	Inner to outer neritic
Tropisurcula milamensis n. sp.	a	a	Inner to outer neritic?`
Tropisurcula (Eodrillia) planus n. sp.	a	a	Inner to outer neritic
Tropisurcula (Eodrillia) grandis n. sp.		r	Inner to outer neritic
Protosurcula aurora n. sp.	a	a	Inner to outer neritic
Coronia taylori n. sp.	a	a	Middle to outer neritic
Coronia cf .*margaritosa* (Casey,1904)		r	Middle to outer neritic
Hesperiturris nodocarinatus crassus n. subsp.	a	a	Middle to outer neritic
Hesperiturris? monilis n. sp.	c	c	Middle to outer neritic
Hesperiturris? monilis levae n. sp.	r		Outer neritic to slope
Bathytoma cf. nonplicata Harris, 1937	r	c	Outer neritic to slope
Domingella ridgei n. sp.		r	Outer neritic?
Microdrillia rostratula Casey, 1903	c	c	Inner to middle neritic
Microdrillia aff. robustula Casey, 1903		u	Inner to middle neritic
Spirotropis claibornica n. sp.		r	Outer neritic to slope
Eocythara texanum n. gen. n. sp.	c	a	Middle to inner neritic
Eocythara lineata n. gen. n. sp.	r		Middle to inner neritic
Varicobela filum n. sp.		r	Middle to inner neritic
Raphitoma (Microsurcula) georgei reklawensis n. subsp.	r		Middle neritic to slope
Raphitoma (Microsurcula) bastropensis n. sp.		r	Middle neritic to slope
Raphitoma (Microsurcula) iuventae n. sp.	c		Middle neritic to slope
Gegania antiquata texana (Palmer,1937)	r		Inner to outer neritic
Mathilda cf. retisculpta aldrichi Palmer,1937	r	u	Inner to outer neritic
Mathilda cf. clabornensis Aldrich, 1887		r	Inner to outer neritic
Mathilda (Echinimathilda?) cribraea n. sp.	u	u	Inner to outer neritic
Mathilda (Fimbriatella) iugum n. sp.		r	Inner to outer neritic
Glyptozaria americanae n. sp.		r	Outer nertitic
Pseudomalaxis reklawensis n. sp.	r	a	Middle to outer neritic
Pseudomalaxis acuta n. sp.	r		Middle to outer neritic
Architectonica (Stellaxis) reklawensis n. sp.	r	u	Inner to middle neritic
Architectonica (Patulaxsis?) fimbiaea n. sp.	r		Inner to middle neritic
Architectonica (Granosolarium) aldrichi caterva n. sp.	r	u	Inner to middle neritic
Architectonica (Granosolarium) geminicostata n. sp.	c	c	Inner to middle neritic
Trimalaxis ora n. gen. n. sp.		r	Inner to middle neritic
Hastula milamensis n. sp.	u	c	Beach to middle neritic
Hastula (Bulbihastula) ampulla n. subgen. n. sp.	c	a	Beach to middle neritic
Hastula (Bulbihastula) longifera n. subgen. n. sp.	u		Beach to middle neritic
Mnestia rotunda n. sp.	r	u	Inner to outer neritic
Mnestia confusa n. sp.	r	c	Inner to outer neritic
Volvulella reklawensis n. sp.	c	r	Middle to outer neritic
Retusa (Cylichnina) notata n. sp.		c	Intertidal, bay to outer neritic
Retusa (Cylichnina) cf.*adamski* Palmer,1937	r	r	Intertidal, bay to outer neritic
Ringicula cf. trapaquara Harris, 1895	r	c	Shallow to inner neritic
Philine sp.		r	Inner to outer neritic
Acteon pomilis punctatus I. Lea, 1833	r	c	Deep inner to outer neritic
Semiacteon texanum n. sp.	r	r	Inner to outer neritic
Pyramidella (Syrnola) pirum n. sp.	r	u	Beach to outer neritic
Pyramidella (Cossmannica) perexilis (Conrad,1865)	a	u	Beach to outer neritic
Pyramidella (Cossmannica) filamentosa n. sp.	c	r	Beach to outer neritic
Pyramidella (Cossmannica) tundrae n. sp.	c	c	Beach to outer neritic
Pyramidella (Cossmannico) tundrae zigguratum n. sp.		r	Beach to outer neritic
Odostomia (Doliella?) ova n. sp.		c	Bay to outer neritic
Odostomia spp.		r	Bay to outer neritic
Turbonilla cf. *neglecta* Meyer,1886	r		Bay to slope
Turbonilla (Ptycheulimella) meta n. sp.	c	u	Bay to slope
Turbonilla (Pyrgiscus) sp.	r		Bay to slope
Umbraculum tomaculum n. sp.	r		Inner to middle neritic
CEPHALOPODA			
Belosepia pennae n. sp.	c	c	Pelagic or neritic to benthic
Angulithes elliotti Stenzel, 1940		r	Pelagic or neritic to benthic
Aturia cf. turneri Stenzel, 1940	r	r	Pelagic or neritic to benthic

PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology usually comprises two or more separate papers in two volumes each year. The series is a publication outlet for significant, longer paleontological monographs (*i.e.*, more than approximately 50 printed pages), for which high quality photographic illustrations and the large quarto format are required.

Submissions are welcome from any author, regardless of institutional or organizational affiliation. Authors must, however, be members of the Paleontological Research Institution at time of publication; annual membership is currently US$25.00. Publication costs of the *Bulletins* are heavily subsidized by the Institution, but authors are currently required to pay illustration charges at a rate of $120.00 per plate and $35.00 per text-figure.

Important references for style and format are 1) *Bulletins of American Paleontology* "Instructions for Authors" (volume 108, number 347, pages 149–153); 2) *Chicago Manual of Style* (fourteenth edition) 1993. Recent issues of the *Bulletins* provide useful guides but note changes with the "Instructions for Authors" mentioned above.

Manuscripts must be typewritten, and double-spaced *throughout* (including direct quotations, tables and references). All manuscripts should contain a table of contents, lists of text-figures and/or tables, and a short, informative abstract that includes names of all new taxa. Format should follow that of recent numbers in the series. All measurements must be given in the metric system, alone or in addition to their English system equivalents. The maximum dimensions for photographic plates are 178 mm × 229 mm (7 inches × 9 inches; outlined on this page). Single-page text-figures should be drafted for reproduction as single column (82 mm; 3¼ inches) or full page (178 mm; 7 inches) width, but arrangements can be made to publish text-figures that must be larger.

Authors must provide three (3) printed copies of the text and accompanying illustrative material. Authors are *strongly* encouraged to prepare their manuscripts on word processors, as this considerably expedites publication. On initial submission, however, only printed copies of the manuscript should be sent; the disk copy should be retained so that revisions can be made after the review process. The text and line-drawings may be reproduced xerographically, but glossy prints at publication size must be supplied for all half-tone illustrations and photographic plates. These prints should be identified clearly on the back.

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